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Railway Survey in Northern Patagonia, Argentina

By D. L. Reaburn*

SYNOPSIS—The most southerly transcontinental railway in the Western Hemisphere is the San Antonio Nahuel Huapi Railway in northern Patagonia, Argentina. It is already partially completed, and will extend eventually from San Antonio, Argentina, to Valdivia, Chile. This article describes the existing portions of the railway and gives an account of the preliminary and location surveys for the projected lines, together with many interesting facts in regard to the country in the foothills of southern Andes Mountains.

Fig. 1. Bariloche, Terminus of the San Antonio Nahuel Huapi Railway; Looking West across the Lago Nahuel Huapi

Projected Railway System—The San Antonio Nahuel Huapi railway now under construction in northern Patagonia by the Argentine Government, passes through a zone adjacent to the 41st parallel of south latitude, from Puerto San Antonio on the Atlantic coast to Lago (Lake) Nahuel Huapi in the Andes Mountains, a distance of about 650 km. At Lago Nahuel Huapi, it is proposed to establish an industrial city.

From the terminus of Lago Nahuel Huapi there are three proposed extensions. The western extension is planned to follow in a northeasterly direction along the shore of the lake for some 100 km., thence over a low divide, and around the western ends of Lagos Traful and Villarino to the Chilean boundary at Pass Cajon Negro, in the crest of the Andes, where a tunnel nearly 2 km. long will be required. This pass, situated in lat. S. 40° 23′, long. W. 71° 41′, is at the head of the Rio Rupuminica, which flows northeasterly for some 70 of 80 km., and empties into Lago Ranco, one of the largest lakes in Chile.

The railway, if constructed, will probably follow this river to the lake and along its north shore, thence, in a northeasterly direction through comparatively easy country, for about 50 km. to a connection with the Chilean Longitudinal railway, which has a Pacific coast terminus at Valdivia.

The northern extension will follow down the Rio Limay for some distance and thence along the eastern base of the Andes to San Martin on Lago Lacar, a distance of about 150 km. The southern extension will follow the south shore of Lago Nahuel Huapi to Bariloche, thence via Lagos Gutierrez and Mascardi and the Rio Manso to the headwaters of the Rio Chubut, a distance of about 350 km., and from there in a southeasterly direction across Patagonia to some point on the Atlantic coast.

This railway system, when completed, will open vast areas of the sheep and cattle country of Patagonia, the beautiful and fertile lake and valley region of the Andes,

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and will be the most southerly transcontinental railway on the American continents.

The line is now in operation from San Antonio to Maquinchao. The construction of about 400 km. has been completed. Final location to Lago Nahuel Huapi and plane-table reconnaissance surveys on a scale of 1 : 50,000 of the western extension to the Chilean boundary, the northern extension to San Martin and the southern extension to the Rio Chubut have also been completed.

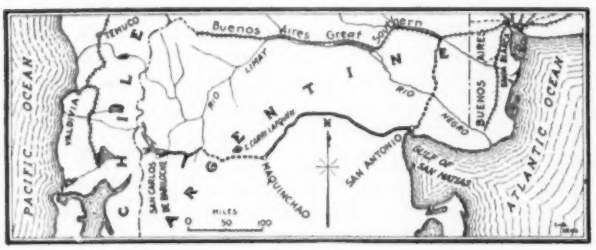

FIG. 2. SKETCH MAP OF NORTHERN PATAGONIA, ARGENTINA, SHOWING PROJECTED MAIN LINE; BRANCHES NOT SHOWN

These railways are being projected by the Argentine Government, as a part of the general plan for developing the country. The Argentine is a country of great resources, and the credit of the Government is good, but under the law the only funds available for railway construction are those provided from the sale of the public lands, so that the work of construction is more or less intermittent.

POSSIBLE HYDRO-ELECTRIC DEVELOPMENT—About 15 km. below the outlet of Lago Nahuel Huapi, on the Rio Limay, there is a fine natural dam site, where by constructing a dam 30 m. high about 200,000 hp. of electrical energy may be developed. The average discharge of the river dtermined by measurements extending over a period of ten years is about 500 cu.m. per sec. The area of the lake is about 650 sq.km., and the mass diagram constructed from the discharge data shows that the flow can be regulated by raising the low-water level of the lake about 4 m.

CHARACTER OF THE COUNTRY—The climate and topographic conditions of this section of Patagonia are very much like those of eastern Washington, Oregon and Nevada. There is but little rainfall during the summer season, and the country is subject to strong winds. From October to May there is scarcely a day when the wind does not blow.

Along the Atlantic coast there is a desert strip; further west is a zone of plateaus of volcanic rocks and some mountains that rise to an elevation of perhaps 5000 ft. Beyond these mountains is again a broad depression filled to some extent with glacial deposits, extending to the foothills of the Andes, which are forested up to the glaciers of the Cordillera.

The Andean region is one of lake and glacier scenery of great beauty, and it is destined to be one of the noted summer resorts of the world. It is even now visited in summer by large numbers of people from Europe and from South American cities.

The Chile-Argentine Co., a German corporation, has a concession from the two governments for operating a transportation line between Bariloche, on the south shore of Lago Nahuel Huapi, and Punta Varas, a station of the Chilean Longitudinal railway on Lago Llanquihue. Small steamers ply on the lakes, and between them is wagon and pack-mule transportation.

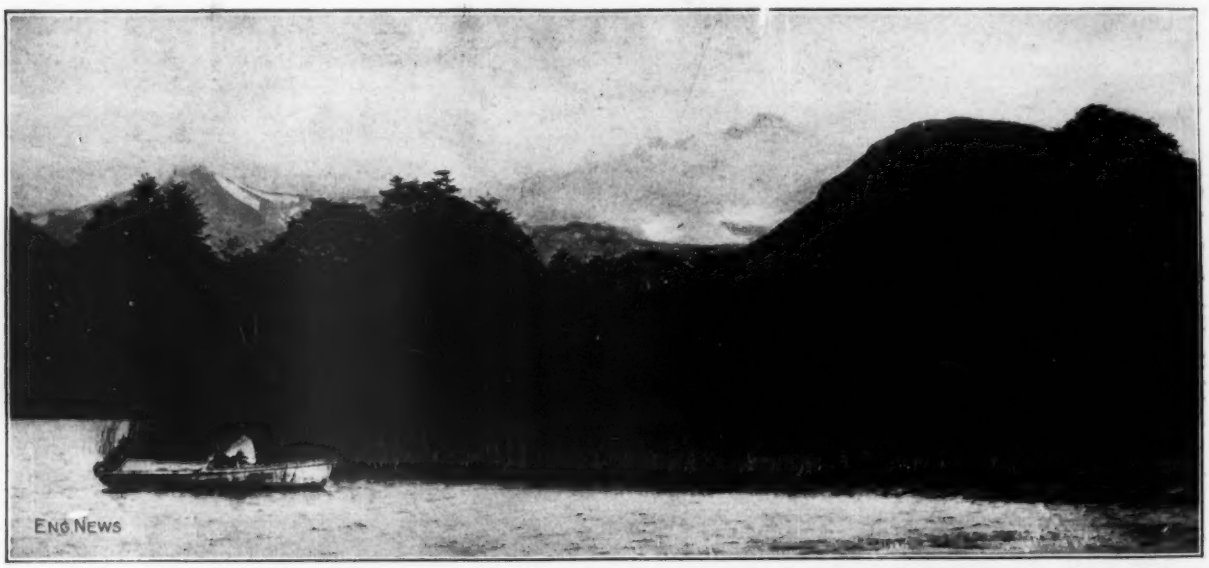

FIG. 3. MOUNT TRONADOR FROM ACROSS LAGO HESS, AT THE MOUTH OF THE RIO MANSO, NEAR THE LINE OF THE SOUTHERN EXTENSION OF THE SAN ANTONIO NAHUEL HUAPI RAILWAY

At Puella on Lago Todos Santos at the western base of the main divide there is a tourist hotel. In this mountain range are a number of peaks 12,000 ft. high, several of which are volcanoes. In the mountains there is an abundance of fish and game, while on the pampas large herds of guanaco and ostriches run wild. The first 450 km. of the railway line present no difficulties of location and construction except scarcity of water. The line from km. 450 to km. 650 passes through a portion of the plateau which is badly broken and the work of location and construction is much heavier.

Topographic and Geologic Surveys—In 1910, while in Buenos Aires as a delegate from the United States to the International Map Congress, Bailey Willis, of the United States Geological Survey, entered into a contract with the Argentine Minister of Public Works to conduct topographic and geologic surveys in this region, with the primary object of determining the artesian water resources.

In January, 1911, Mr. Willis sailed from New York with a full complement of engineers and geologists. The writer was offered the position of chief topographer, but was unable to accept on account of unfinished work on the Los Angeles Aqueduct. The investigations carried out during 1911 indicated that there are no ground-water resources in the region; but the topographic mapping, which was done on a scale of 1 in 100,000 with 20-m. contours over a belt some 30 miles wide, developed the fact that the original location of the railway line could be improved. So Mr. Willis was instructed to secure an engineer from the States to relocate the western portion of the line.

Fig. 4. Lago Lacar San Martin, Terminus of the Northern Extension of the San Antonio Nahuel Huapi Railway

Fig. 5. Dam Site on the Rio Limay, 15 Km. below the Outlet of Lago Nahuel Huapi; Looking West toward the Andes

The writer was engaged for this work and accompanied by J. G. Morgan, of Los Angeles, as assistant, sailed from New Orleans on Aug. 10, 1912. A stop of five days was made on the Isthmus to inspect the work on the Panama Canal; and several days was spent in each of the principal ports on the west coast of South America.

From Santiago, Chile, we proceeded to the southern end of the Chilean Government railway, and then crossed the Andes to Bariloche, on Lago Nahuel Huapi. At Bariloche, we were met by the topographer, W. B. Lewis, of the American contingent, who conducted us eastward through the region to be surveyed, to San Antonio, Argentina, on the Atlantic coast, where the party with the equipment was assembled. We then moved westward to Huan Lluan in the vicinity of km. 450, where the survey of the line was started on Oct. 13, 1912.

Preliminary Survey

The party was composed of the party chief, transitman, levelman, draftsman, five rodmen, cook, capataz, or foreman, and six to ten peons; and the equipment included 40 head of horses and mules, camp wagon and saddles. All members of the party were furnished with saddle horses. Two peons accompanied the field party to care for the horses and prepare the lunch at noon. As the grazing was very scant and but little grain was fed, the horses were used on alternate days, to enable them to stand up to the work. About 15 km. was the maximum distance worked either way from camp. The party generally traveled on a dead run, so that the maximum time consumed in travel was less than an hour each way per day.

The preliminary survey was conducted by the transit stadia method, controlled in azimuth and distance by a secondary triangulation system carried throughout the whole length of line surveyed. The general route of the survey was projected on the 1 in 100,000 topographic maps (of Mr. Willis' survey); and the geodetic triangulation positions were recomputed on a rectangular coordinate system, with the starting point as the origin, for the secondary system.

Owing to the open country and commanding position of the primary triangulation stations, the secondary system was very economically established. A large number of the tie points were obtained directly from the primary stations by solutions of the three-point problem. The average distance between the tie points was about 4 km., so that one tie for each day's work was obtained. The stadia line was plotted to a closure and the error distributed before any topography was plotted.

In order to confine the area covered by the preliminary topography to as narrow limits as possible, the route was selected in advance of the topography party, by the locating engineer, and was marked by flags tied to the brushes, to guide the topographer. A stadia hand level was used to great advantage on this reconnaissance work, grades being established by means of the wire intervals in the telescope.

Topography Party—The topography party was composed of the transitman, recorder, four to five rodmen and levelmen. The rodmen followed out the contours, and gave shots at all changes of direction. The levelman assisted in spotting the rodmen on the contour.

The control in elevation was carried by the transitman, duplicate readings being taken between all transit stations. In cases where the difference in elevation between two transit stakes was too great to obtain the difference by a direct level reading, the interval method was used and checked by a vertical angle reading.

On flat and rolling ground each 2-m. contour was traced out, but on the steeper slopes each 4-m., and in some cases, each 6-m. contour only was followed.

MAPS—The stadia notes were plotted to a scale of 1:4000 on sheets 0.5 m by 0.75 m. in size. Each sheet was divided up into kilometer squares, and the lines numbered to correspond with the coördinate system of the triangulation. On these sheets the line was projected, profiles constructed and comparisons made between alternate routes.

ERRORS—The errors in closure of the stadia line were small, and except in cases where the azimuth was in error at the closing point, but little adjustment was necessary. The discrepancy in elevation of the stadia line obtained by comparison with the profile levels over the located line is shown in the accompanying table. From this table it is seen that the total difference between Km. 465 and Km. 628 + 500 was 0.49 m., and the maximum intermediate variation was 1.34 m.

TABLE SHOWING DISCREPANCY IN ELEVATION BETWEEN STADIA LINE AND PROFILE LEVELS

Kilometer	Meters Approx. elev.	Meters Discrepancy	Kilometer	Meters Approx. elev.	Meters Discrepancy
465 + 00	895	0.00	556 + 500	1030	+1.10
469 + 00	935	0.00	557 + 300	1040	+1.33
482 + 640	975	—0.09	558 + 00	1060	+1.34
483 + 260	985	—0.17	561 + 400	1110	+1.12
483 + 640	985	—0.30	562 + 400	1100	+1.05
483 + 840	990	—0.19	564 + 300	1080	+0.92
488 + 940	990	+0.10	565 + 300	1060	+0.80
490 + 900	987	+0.23	566 + 500	1040	+0.98
494 + 840	1010	+0.28	567 + 00	1030	+0.99
502 + 640	1020	+0.54	569 + 100	1010	+0.92
502 + 940	1022	+0.55	570 + 200	1000	+0.90
503 + 500	1030	+0.67	574 + 00	970	+0.65
503 + 700	1035	+0.72	575 + 500	965	+0.64
504 + 500	1045	+0.61	575 + 800	965	+0.50
509 + 00	1090	+0.86	576 + 300	970	+0.43
510 + 00	1075	+0.66	579 + 300	960	+0.46
510 + 500	1080	+0.67	581 + 900	960	+0.39
511 + 800	1050	+0.62	584 + 200	950	+0.56
513 + 100	1025	+0.52	587 + 700	950	—0.05
514 + 00	1020	+0.48	589 + 00	985	—0.10
516 + 200	1040	+0.63	590 + 700	1010	+0.34
517 + 600	1060	+0.70	593 + 400	1050	+0.15
518 + 800	1090	+0.69	594 + 300	1030	+0.27
521 + 00	1030	+0.50	597 + 600	1000	+0.24
524 + 500	990	+0.51	600 + 200	950	+0.32
527 + 00	950	+0.56	601 + 800	925	+0.11
533 + 300	890	+0.76	606 + 800	895	+0.07
535 + 00	880	+0.79	608 + 200	875	+0.04
538 + 100	850	+1.05	609 + 500	865	+0.00
539 + 200	835	+1.22	611 + 200	850	+0.04
540 + 200	830	+1.21	613 + 400	832	—0.09
542 + 600	850	+0.85	615 + 700	815	—0.25
546 + 200	870	+0.81	616 + 600	825	+0.25
547 + 600	890	+0.81	617 + 000	815	—0.12
550 + 500	940	+0.88	617 + 600	815	—0.20
553 + 400	980	+1.04	618 + 700	815	—0.21
553 + 300	980	+1.09	619 + 400	820	—0.20
554 + 400	990	+1.19	620 + 700	810	—0.21
555 + 000	1025	+1.01	623 + 000	800	—0.24
555 + 600	1030	+0.91	628 + 500	770	—0.49

The accuracy of the topographic work was thoroughly tested in projecting the line upon the ground by means of a comparison of profiles, which were in all cases identical excepting in small details which 2-m. contours would not bring out; and in no case was it found necessary to revise the line on account of errors in the map.

PROGRESS—The preliminary survey was completed to Bariloche, Jan. 13, 1913, three months from the date of beginning:

Total number of days in the field	90
Total number of working days	67½
Total length of lines surveyed, km	285.8
Average progress per calendar day, km	3.18
Average progress per working day, km	4.24

LOCATION SURVEY

As the party was to proceed to San Antonio on the Atlantic coast at the completion of field work, in order to save time, the line was staked out upon the ground backwards. This work was begun immediately after completion of the preliminary survey and was finished Apr. 27, 1913.

About two weeks of this time, *en route,* was devoted to extending the belt of topography in the rough sections to include the ground covered by the 1.6% maximum grade. It had been decided to increase the maximum grade from 1.3% to reduce construction costs. The minimum radius of curve used on the 1.6% ruling grade was 300 m., equal to a 3° 48′ metric or a 5° 50′ standard curve. The grades were not compensated for curvature, so that virtually the ruling grade was 1.8%.

It was assumed that the broad considerations affecting the location had received proper attention from the personal examination of the country and from the studies and comparisons of the different routes made from the topographic maps; so after the line had been fixed approximately in position upon the ground as shown by the projection on the topographic map, it was considered that the map had served its purpose and that future studies for minor changes should be based upon this preliminary location.

FIELD MAPS—To accomplish this, tracings of the topographic maps, showing the topography, the projected line and grade elevations every 100 m., as given on the profile of the projected location, were made and carried into the field by the locating engineer. The azimuth and distance to each P. I. from the nearest transit station of the preliminary line were scaled and written on the tracing. From these data flag poles of bamboo were set at each P. I. by stadia. The line was ranged out between the P. I.'s, when not intervisivle, and carefully examined by eye. Any necessary changes in position of the P. I.'s were then made and the changes were marked on the tracing, which was then turned over to the transitman in charge of the location party.

Lost motion in the party was thus reduced to a minimum, and the line was staked out at an average rate of about 3 km. per working day. Accidental errors in the chaining were detected by comparison with the scaled lengths of the tangents, and the angle measurements were checked against the triangulation. The discrepancy in azimuth at Km. 465 was 1′ 30″, and the maximum at intermediate points was only 2′ 00″.

STATION MARKERS—Three sizes of stakes were used: 1x1x12-in. for the 20-m. stations; 2x1x18-in. for the 100-m. stations and 4x1x18 in. for the kilometer stations. The numbers on the kilometer and 100-m. stakes were stamped with branding irons. Near each kilometer stake a 4x4x36-in. B. M. post was planted. These were painted white.

SUMMARY

The physical characteristics of the line between Km. 465 and Km. 638 + 500 are given in the following summary:

ALIGNMENT

Total in tangent, m	119,873
Total in curve, m	53,632
Per cent. of tangent	69.1
Per cent. of curve	30.9
Longest tangent, m	6723
Shortest tangent, m	17
Longest curve, m	1418
Total number of curves, m	209
Total deflection to right	3846° 28′
Total deflection to left	3662° 38′
Total deflection	7509° 06′
Deflection per curve	35° 56′
Deflection per kilometer	43° 17′
Radius of min. curve, m	201.12

GRADES

Total length in horizontal, m	18,025
Total length in rise, m	68,840
Total length in fall, m	86,639
Total rise, m	815
Total fall, m	940
Total rise and fall, m	1755
Rise and fall per kilometer	10.11
Maximum grade, per cent	1.6
Longest maximum grade, m	16,000

EARTHWORK

Fill, cu. m.	1,655,268
Cut earth, cu. m.	410,363
Cut soft rock, cu. m.	392,024
Cut hard rock, cu. m.	689,142
Total cu. m.	3,145,797
Per kilometer	18,131

STRUCTURES

97 culvert pipes, m. diam.	0.60
15 culvert pipes, m. diam.	1.00
13 masonry box culverts, m. wide	2.00
5 masonry arch culverts, m. wide	2.00
5 masonry arch culverts, m. wide	3.00
1 masonry arch culvert, m. wide	5.00
4 steel bridges, m. span	5.00
1 steel bridge, m. span	10
5 steel bridges, m. span	20
4 steel bridge, m. span	40
1 steel bridge, m. span	60
1 steel bridges, long (50 m. span)	100
2 steel bridges, m. long (60 m. span)	300

Total length of bridges 835 m.
Mine tunnels—total length 1530 m.
Longest tunnel, 800 m.

Heavy Rock Sea Wall at Manhattan Beach, L. I.

A heavy rock sea wall, which is claimed to have withstood without damage the battering of the sea during the severe storms of Dec. 25-26 and Jan. 3-4, is that under construction at Manhattan Beach, L. I. The effects of these storms on the weak shore bulkheads of Seabright,

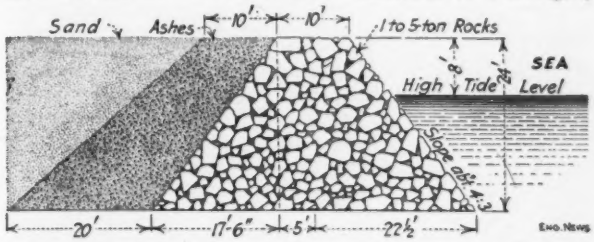

FIG. 1. SKETCH SHOWING STEEP SLOPE AND METHOD OF FILLING IN BEHIND THE SEA WALL

N. J., and the damage at Arverne, Rockaway, Sea Gate, etc., were described in ENGINEERING NEWS, of Jan. 8.

The above sea wall has been under construction for the past three years and stretches from the junction of Corbin Place and Oriental Boulevard, at the southwest corner of Brighton Beach to the water front of the Oriental Hotel at Manhattan Beach, about 1½ miles east, where the construction work is in progress at the present time. Ultimately (in about a year) the sea wall will extend to Sheepshead Bay inlet, making a total length of 2¼ miles.

The sea wall is constructed of rocks weighing from one to five tons each. It is 40 to 50 ft. wide at the base and about 10 ft. wide on top, as shown in the sketch (Fig. 1). The rocks are obtained from the excavation of the new Lexington Ave. subway, New York City, and are lightered over to the job, where they are unloaded by derrick boats shown in Fig. 1.

The sea wall at Corbin Place extends about 800 ft. out into the water. At this point beach erosion by the action of the sea had been severe. Through the protection of the sea wall the beach (about 1500 ft. long and of varying width) has been rebuilt and retained. The remaining part of the sea wall was built about 300 ft. off shore and the intervening space filled in.

The reclamation work was performed in the following manner: After the construction of a given section of the rock wall, ashes obtained from the New York Edison Co. and lightered over to the job were placed by the derrick boats against the inside of the wall. The ash fill, 20 ft. wide at the base of the wall and 10 ft. wide at the top, effectually preventing the sand—which was now pumped in—from escaping through the interstices of the wall. The sand suckers worked day and night and this badly scoured portion of the beach was rebuilt in one month. The sand suckers were situated at the end of a wooden trestle, 1000 ft. long. The trestle is just visible at the extreme left of the photograph. In the filling-in process, the old shore bulkheads which formerly served as a protection to the beach property are covered by three to four feet of sand.

The work is carried on under the direction of Charles Voorhees, Engineer for the Manhattan Beach Estates, by O'Brien Bros., Inc., contractors, of 54 South St., New York City. The information contained in this article was obtained from the contractor.

FIG. 2. METHOD OF CONSTRUCTION OF THE SEA WALL AT THE BADLY SCOURED PORTION OF BRIGHTON BEACH

A More Liberal Policy Toward Settlers on U. S. Reclamation Service Projects was agreed on as desirable in a conference between Secretary of the Interior Lane and senators and representatives from irrigation states on Jan. 29. Congress will be asked to double the time now allowed for the repayment of the costs of reclamation works, making the period 20 instead of 10 years. The first payment under the new plan would be 5% of the total on making application for water rights. There would then be five years free from payments, then five years with 5% installments and finally ten years with 7% payments.

Siphon Spillways on the Glens Falls Feeder, New York State Barge Canal

By G. F. Stickney*

In order to provide water for the Champlain division of the new Barge Canal, it was necessary to reconstruct the bypasses around the locks of the old Glens Falls Feeder, a navigable channel some 7 miles long through

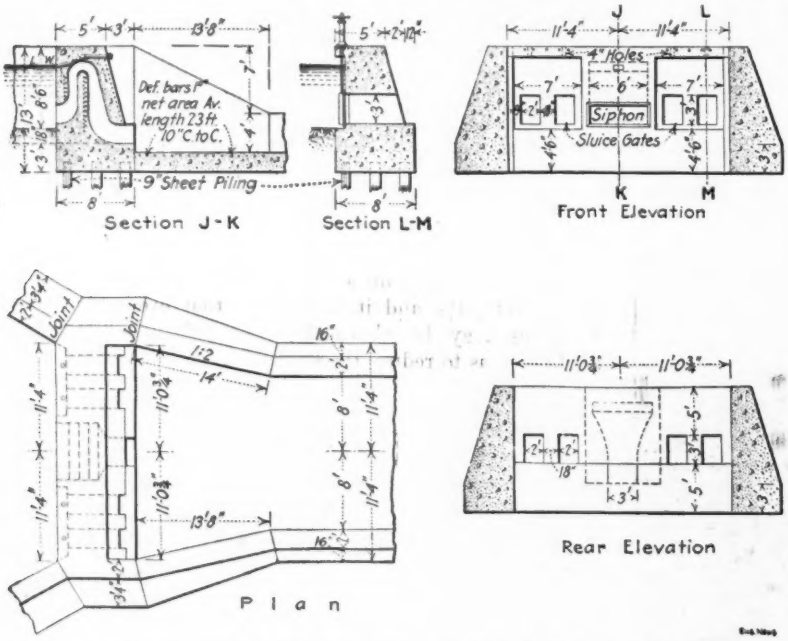

Fig. 1. Details of By-Pass at Locks 2 and 3, Glens Falls Feeder, Champlain Canal

which water from the Hudson River will be brought to the summit level of the canal. These bypasses, which were designed by the writer, are all similar in construction to that shown in Plan No. 1, and the accompanying views, but vary in length according to location.

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Each consists of a channel 16 ft. wide and at least 4 ft. deep, with concrete walls at the sides and a concrete bottom, the latter forming a series of level steps separated by vertical drops 3 ft. deep (Fig. 1). The lengths of the level portions are arranged so that the channels conform approximately to the slope of the ground surface.

Across the head of each bypass is a bulkhead shown in Fig. 2, containing four 2x3-ft. openings with sluice gates, and a siphon spillway, the latter having a cross-sectional area of 6 sq.ft. The bulkheads are identical at each of the eight bypasses on the Feeder and they are of interest on account of the spillways.

The maximum amount of water required for the operation of the canal is estimated to be 260 cu.ft. per sec. and at normal stage of water the four sluice openings will supply 252 cu.ft. per sec., while 8 cu.ft. per sec. will spill through the siphon.

The pools, which the bypasses connect, are small in area with normal water surfaces slightly below the tops of the embankments. The maximum permissible rise in the water level is 6 in., which fluctuation does not admit of much storage and consequently the rate of outflow must be practically the same as the rate of inflow or else the embankments will be overtopped within a brief period of time. While the sluice gates will ordinarily be set so as to feed the same amount of water at each bulkhead, some variations in the flow will occur occasionally on account of lockages or from other causes. Any increase in the flow will be taken care of, automatically, by the siphon spillway which has a capacity of 70 cu.ft. per sec. and operates when a rise of 3 in. in the pool occurs. The flow through the siphon, being under a head, is at a high velocity and thus a large vol-

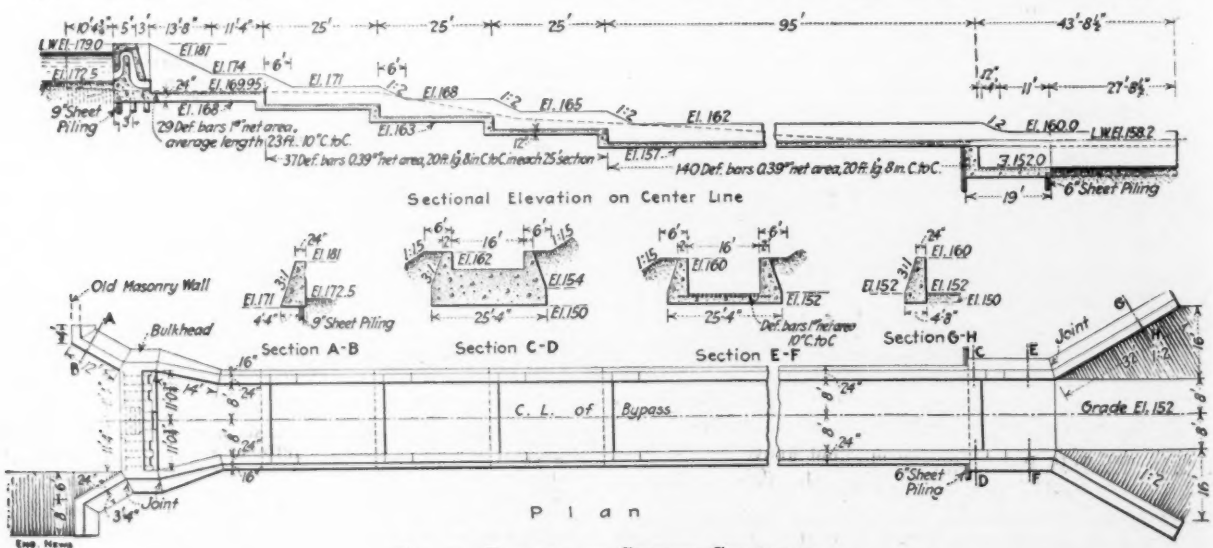

Sectional Elevation on Center Line
9" Sheet Piling
29 Def. bars 1" net area, average length 23 ft. 10" C. to C.
37 Def. bars 0.39" net area, 20 ft. lg. 8 in. C. to C. in each 25' section
140 Def. bars 0.39" net area, 20 ft. lg. 8 in. C. to C.
6" Sheet Piling
Old Masonry Wall
Bulkhead
Section A-B
Section C-D
Section E-F
Section G-H
C. L. of Bypass
Grade El. 152
Joint
Plan

Fig. 2. Details of Siphon Spillway

me of water is discharged through a small conduit. An overflow spillway to provide for variations in flow when the depth of water on the crest is from 3 in. to 6 in., would have been of considerable length and at several of the sites there was no space available for such a structure. The inlet of the siphon, placed 4 ft. below the normal water level, is 2 ft. high by 6 ft. wide, with an area of 12 sq.ft. The conduit contracts just beyond the inlet to a section of 1x6 ft., which is maintained to a point just beyond the crown and thence gradually changes to a section 2x3 ft. at the outlet, keeping a constant area of 6 sq.ft. throughout. The crown or highest part of the siphon extends from ½ ft. below to ½ ft. above the normal water level, so that a small amount of water spills through the siphon at all times, there being no objection to this waste since water is constantly being fed through the sluice openings.

An air vent 4 in. high by 12 in. long, which controls the action of the siphon, pierces the upstream wall, at the

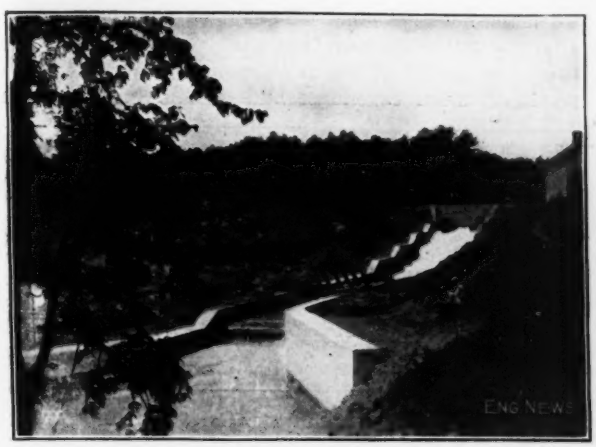


FIG. 3. DOWNSTREAM VIEW OF SIPHON SPILLWAY. GLENS FALLS FEEDER

normal water level (Fig. 2). The outlet of the siphon is never completely submerged. The siphon primes when the water surface rises 3 in. and at that stage the top of the air vent is submerged 1 in., so that no air can pass into the crown. The water flowing through the crown exhausts the air, remaining above the water level, and the siphonic action is immediately established. The priming takes place very quickly, in fact as soon as there is a sufficient depth of water to completely seal the air vent. When the water in the pool is drawn down, so as to expose the top of the vent, air rushes into the crown and the siphonic action ceases.

In order to test the efficiency of the siphon a sharp-crested weir was placed at the lower end of one of the bypasses to measure the discharge. The weir was made of a 2-in. plank, having an iron plate with its top edge machined to a true plane, projecting above the wood, on its upstream side. A vertical plank at each end, with a similar iron plate on its inner edge, extended above the crest and reduced the length to 13.93 ft. The crest of the weir was 0.95 ft. above the bottom of the channel. Baffle boards were placed in the channel above the weir to check the velocity and to equalize the flow across the bypass.

The head on the weir was measured by a bottle gage, in a stilling box, the staff of which was graduated to hundredths of a foot. This gage was located at the side of the channel 16 ft. above the weir. A similar gage measured the head on the siphon. A series of observations were made, while the siphon was in full operation, reading the gages at one-minute intervals.

The discharge was computed by Bazin's formula $Q = m\,l\,h\,\sqrt{2gh}$ using the coefficient m as determined for a weir 0.98 ft. high and correcting the length of the weir, on account of the end contractions, by Francis' formula $l = l' - 0.2\,h$.

The result of the test is shown in the following table:

Time a.m.	Depth on weir ft.	Discharge cu.ft. per sec.	Head on siphon ft.	Efficiency of siphon %
11.-9	1.19	68.9	5.64	60.3
10	1.21	70.8	5.66	61.8
11	1.20	69.9	5.67	61.0
12	1.21	70.8	5.70	61.6
13	1.21	70.8	5.72	61.5
14	1.20	69.9	5.74	60.6
15	1.20	69.9	5.75	60.5
16	1.20	69.9	5.77	60.4
17	1.21	70.8	5.75	61.3
18	1.20	69.9	5.63	61.2
19	1.21	70.8	5.58	62.2
20	1.20	69.9	5.50	61.9
Average				61.19

Other tests made on a small model siphon gave an efficiency of 75% and it is believed that even higher efficiencies may be obtained by modifying the design slightly so as to reduce the losses in head that occur.

The Production of Petroleum in 1913 in the United States exceeded that of any previous year, according to the estimate of David T. Day, of the U. S. Geological Survey. The amount produced was 240,000,000 bbl., as against 222,113,218 bbl. in 1912; and the rate of increase of production was greater at the end of 1913 than at the beginning of that year. California increased at least 10,000,000 bbl. over 1912, reaching almost 100,000,000 bbl. The consumption in California almost equaled the production; and the addition to stock was very small. Oklahoma also showed a significant increase, with about 6% addition to the stock; Texas and Louisiana increased their production. The output of the Gulf field declined, but this was more than offset by increases in northern Louisiana and Texas. Wyoming showed an increase from the Salt Creek field of about 400,000 bbl. Other states, generally, showed a decline, which was greatest in Illinois (over 6,000,000 bbl.)

A Report on Flood Protection at Fort Wayne, Ind., has been made by A. W. Grosvenor, of Fort Wayne, to the Fort Wayne Citizens' Flood Prevention Committee. The report states that the St. Mary's River, one of the two streams forming the Maumee River at this point, brought down the larger part of the water which caused the flood, and that contraction of the channels, due to filling in and other obstructions by the owners of property along the banks, was a large contributory cause.

The crest of the flood reached an elevation 4 to 6 ft. above the highest previous flood levels, those of 1883 and 1908. The flow through the city at the crest of the March flood is estimated as about 20,000 cu.ft. per second. In addition, the St. Mary's River discharged about 6000 cu.ft. per second, through the Maumee, through a 9-mile dry channel which bypasses the city, and some 9000 cu.ft. per second overflowed the flat divide between the Maumee and the Wabash Rivers.

As flood protection measures, it is proposed to utilize for a cutoff channel, the dry valley which extends from the St. Mary's to the Maumee River, and bypasses Fort Wayne, in which there is now located a drainage ditch, called the Trier Ditch, 9.1 miles long. The channels of the St. Mary's, St. Joseph, and Maumee Rivers through Fort Wayne are to be improved and regulated for a capacity of about 27,000 cu.ft. per second, which, with a flow of about 7000 cu.ft. per sec. through the cutoff channel, will allow for a total flood flow past the city of some 34,000 cu.ft. per second.

General bridge improvement is necessary within the city, some bridges requiring only raising, while others require additional spans or complete replacement. At the same time, the channel will be given uniform depth by dredging; to maintain the water line in the low-water seasons, movable dams of the type used on the New York State Barge Canal are proposed. Retaining walls and dikes along the rivers and channels are also proposed. The cost of the entire improvement is estimated at about $1,300,000.

New Water-Works Intake Tunnel and Tower for St. Louis, Mo.

SYNOPSIS—Like many other cities, St. Louis is facing the problem of increasing its water-supply to provide for the growth of the city. It has now commenced work on the duplication of its intake system for the present supply from the Mississippi River, while an independent supply from the Missouri River is contemplated. The accompanying article outlines the general conditions and describes the present and proposed works.

The city of St. Louis, with a present population of about 730,000, draws its water-supply from the Mississippi River, and has its intake works located at the Chain of Rocks, about 10½ miles above the Eads Bridge. The present intake, which was completed in 1892, comprises a 7-ft. tunnel about 2200 ft. long, extending from the pumping station for 550 ft. to a short shaft and then 1600 ft. under the river to a 7-ft. intake shaft. The end of this shaft is covered by a masonry tower, having inlet ports and gates at different elevations of the lower portion. The maximum capacity of the tunnel is about 140,000,000 gal. daily. The average daily pumpage for 1912 was about 98,000,000 gal., including water for cleaning and flushing the settling basins and that lost by evaporation, leaks in basins, etc.

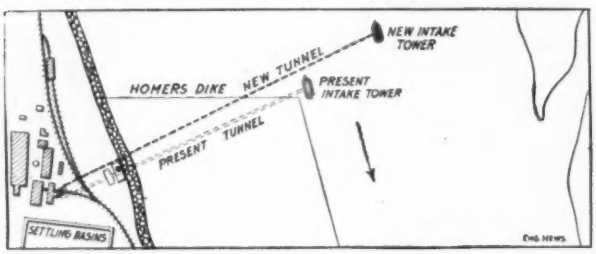


FIG. 1. PLAN OF OLD AND NEW INTAKES AT CHAIN-OF-ROCKS IN THE MISSISSIPPI RIVER, FOR THE WATER-SUPPLY OF ST. LOUIS, MO.

The river water being muddy, all the supply is treated by a clarification process, using lime and iron-sulphate as the coagulant and passing the water through a series of settling basins. This plant is the limiting feature of the supply system, as its capacity may be less than 90,000,000 gal. under favorable conditions, while for 1912 the average daily consumption was about 85,000,000 gal., and the pumpage 98,000,000 gal. The clarification is to be superseded by filtration. The two processes were compared by Edward E. Wall, the water commissioner, in ENGINEERING NEWS, of Oct. 23, last, in connection with a description of the new sand filter plant which is now under construction and which will have a daily capacity of 160,000,000 gal. (ENGINEERING NEWS, Dec. 25, 1913.)

The total pumpage for 1912 was about 30,000,000,000 gal. The per capita consumption has been increasing for some years and is now about 120 gal. per day. The general adoption of meters is recommended as a means of reducing the waste. For 1912, the maximum consumption was 150 gal. during the extremes of hot and cold weather, the waste representing 40 and 60% of this for summer and winter respectively. It is these peak demands which would be greatly decreased by the use of meters. Mr. Wall considers that a still stronger argument is the fact that only by measuring the quantity used by each consumer can an equitable adjustment of rates be made, or a definite knowledge obtained of what becomes of the water pumped. At present, about 33% of the water is metered, and this is used mainly for business purposes.

TROUBLES OF THE PRESENT INTAKE

The capacity of the present intake system is subject to reduction and interruption by two causes: (1) insufficient inlet port area at low stages of the water level; and, (2) blocking of the ports by ice. The location of the intake tower in relation to the ice conditions is such that nearly every winter there is serious trouble from ice. The exceptionally serious conditions of 1911-12, when the flow was practically shut off and the reservoirs almost exhausted before it could be renewed, were recorded by Mr. Wall in our issue of Feb. 1, 1912. As a result of earlier experience he had undertaken the construction of a new port but this had not been completed at the time. This additional port enters the shaft below the base of the tower, and is approached by a short elbow tunnel whose vertical end opens through the river bed.

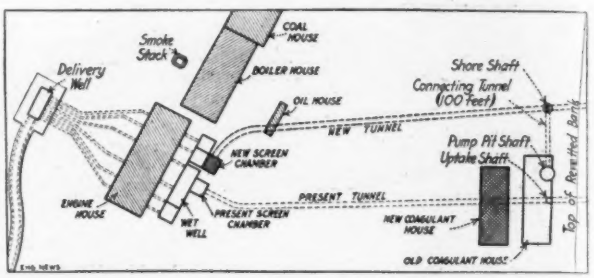


FIG. 2. OLD AND NEW TUNNEL CONNNECTIONS AT THE PUMPING STATION, ST. LOUIS, MO.

Under the original arrangement, at low stages of the river only 45 sq.ft. of port area were available, and a velocity of 4 ft. per sec. was required to maintain a pumpage of at the rate of 120,000,000 gal. With the new gate the area is increased to 65 sq.ft. and the velocity is correspondingly reduced to 3 ft. per sec. This is based on a clear port opening. At certain seasons of the year the river carries a considerable amount of slush ice or frazil ice. This cannot be kept out by screens, and the higher the velocity the greater amount of this slush ice will be carried through the tunnel and into the wet well at the pumping station. There it must be removed by special conveyors and other machinery.

At these particular times the ports are likely to be blocked more or less by ice cakes and by slush ice freezing to the screens. This results in increasing the velocity and increasing the admission of slush ice until there may be so much ice in suspension in the wet well that the pumps cannot be operated.

NEW WATER INTAKE

In view of conditions above described, but more especially in view of the undesirability of a city of this size being dependent entirely upon the one intake for its

water-supply . Mr. Wall has for some years urged the construction of a new intake tunnel and shaft which will not only duplicate the facilites but will eliminate some of the troubles incident to the present system. The old and new intakes are shown in Fig. 1.

The new works were authorized in November, 1912, and after some difficulty in getting satisfactory bids, the contract was let in June, 1913, to the Fruin-Colnon Co., of St. Louis, at $490,355. By Dec. 1, 1913, the shore shaft had been sunk and the tunnel had progressed about 400 ft. in each direction from the shaft. The coffer-dam for the intake tower had been completed and pumped out, and preparations had been made for commencing work on the masonry.

The location of the new tower is such that there will be less trouble from ice blockades. The problem of slush ice and the removal of this ice from the wet well will still have to be considered, but will be less troublesome. With the two intakes, water may be taken at points where the ice conditions are most favorable, and with the greater port area and consequent lower velocities there will be less of this ice drawn through the tunnel into the well.

pointed ice-breaker on the upstream end, while the downstream end has beveled corners. It is built into the rock bed of the river and at the base it is 70 ft. long and 26 ft. 8 in. wide, while at the top (Elev. 114) it is 60 ft. 1 in. x 23 ft. 10 in., with semicircular ends. The tower is of concrete faced with granite, and the top is finished with a corbelled coping course. The tower proper is surmounted by a gatehouse containing the machinery for operating the gates. This building is of stone, with brick interior finish and concrete roof. Its floor is at Elev. 117, and the height is 37 ft. 6 in. to the cornice. Access to this gatehouse is by a ladder, the tower being reached by boats. The construction is shown in Fig. 4.

The interior of the tower is formed with two wells; one of these is 10x11 ft. (with semicircular end) forming an upward extension of the intake shaft, and the other is a rectangular chamber 16x8 ft., the two being connected by a port in the partition wall, which is fitted with gates. There are numerous intake ports through the walls of the tower, these being arranged on the sides and the downstream end, and entering the wells at different elevations for use at the varying stages of water in the river. All of these ports are 4x6 ft., and will be

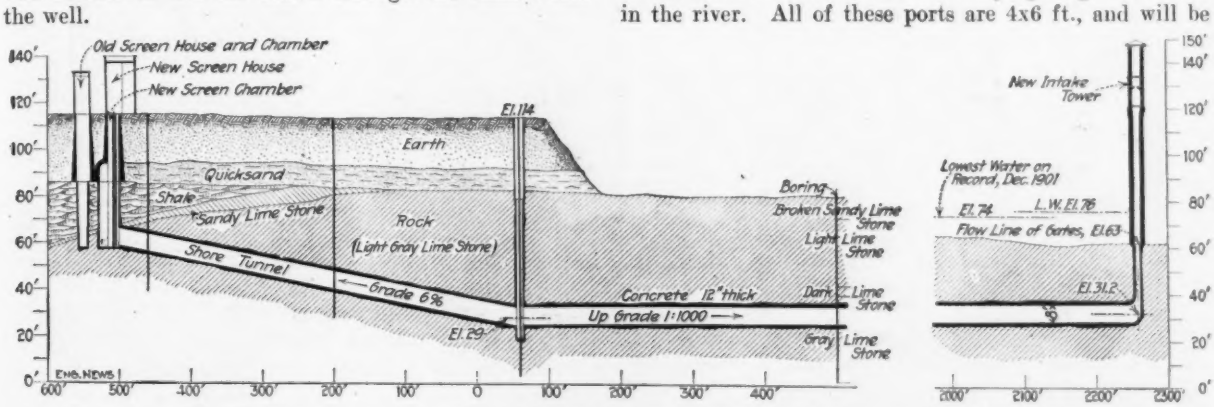


FIG. 3. PROFILE OF NEW INTAKE TUNNEL FOR THE WATER-SUPPLY OF ST. LOUIS, MO.

THE INTAKE TUNNEL—The new intake tunnel will be about 2800 ft. long, extending from a new screen chamber at the wet well of the pumping station to an intake shaft and tower located some 800 ft. north, and east of the present tower. This is shown in Figs. 1 and 2. It is at practically the same elevation and grade as the old tunnel. It will be of circular section, finished to an outside diameter of 8 ft. and will be lined with concrete. In the excavation, no rock projections are allowed within 9 in. of the finished interior surface.

The profile is shown in Fig. 3. From the screen chamber the tunnel has a descending grade of 6% for 560 ft. to a shore shaft, and beyond this it has an ascending grade of 1 in 1000 for 2234 ft. to the intake shaft. It is on a straight line except for a curve of 80-ft. radius (covering an angle of 57°) at the screen chamber. At the shore shaft, the floor of the tunnel is about 90 ft. below the surface, or 57 ft. below the river bed, while at the intake it will be about 34 ft. below the river bed. At this point there is practically no mud or sand deposit upon the rock bed of the river. From the shore shaft a connecting tunnel will run to the pump-pit shaft at the coagulating plant. The shafts will be 8 ft. diameter, with 12-in. concrete lining.

THE INTAKE TOWER—The tower covering the top of the intake shaft is a rectangular structure formed with a

fitted with fixed screens on the outer end, and with sliding screens and gates on the inner end, these being electrically operated from the gatehouse above.

In the concrete are embedded 3-in. fiber ducts for the electric cables, and several 2-in. brass pipes, as shown. The latter will be available for forcing steam, water or air under pressure in order to clear the gates of ice, should this become necessary.

NEW SUPPLY FROM THE MISSOURI RIVER

It is expected that by 1935, the city will have reached a population of one million and in regard to future increase of the water-supply, Mr. Wall considers that steps should be taken to consider a supply of sufficient capacity to meet the demands until about 1960. This means a supply of not less than 300,000,000 gal. daily, unless measures are taken to apply meters for all consumers.

In Mr. Wall's opinion, the limit of the enlargement of the Mississippi River plant (at Chain of Rocks) is a working capacity of 150,000,000 gal. daily. This will suffice until about 1923, and will allow ample time to consider the question of new water-works and to complete such works before there is any liability of a water famine. To double that capacity (to 300,000,000 gal.) at the present site would necessitate large additions to the pumping station and purification system, as well as

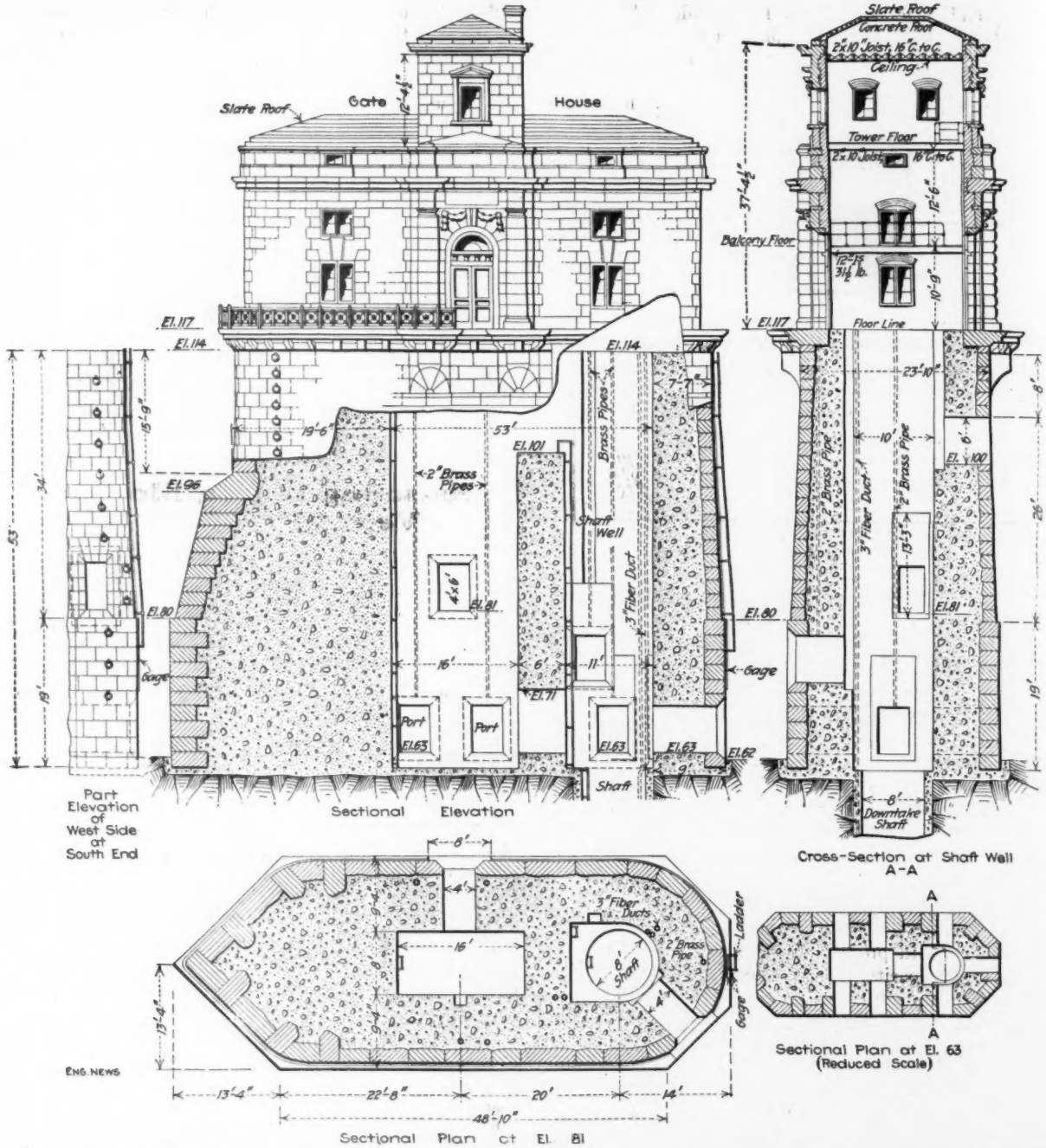


FIG. 4. THE NEW INTAKE TOWER AND GATE HOUSE IN THE MISSISSIPPI RIVER, FOR THE WATER-SUPPLY OF ST. LOUIS, MO.

to the high-service stations, while it would add greatly to the cost of operation.

There are economic reasons also for limiting the total capacity of the present plant as above stated. For one thing, the city limits will be extended eventually, and the Chain of Rocks plant is not located favorably for supplying water west and southwest of the present limits, while the extension of the mains would involve enormous expenditure for an entire re-arrangement of the distribution system. Then again,, the present site is not favorable to the construction of additional plant to bring the total daily capacity to 300,000,000 gal. In addition to this, the Chain of Rocks location is not so desirable as it was 25 years ago; the quality of the water is such as to require expensive purification treatment, the supply is difficult to maintain at certain times, and it necessitates double pumping at all times.

In view of the above conditions an investigation has been undertaken in regard to an additional and independent supply from the Missouri River, with the result that a suitable location has been found about nine miles above St. Charles, Mo., approximately due west from

the city and 16 miles from the Eads Bridge. The water would be pumped 9 miles to a purification plant and reservoirs near Stratman's Hill, and from this point the water could be delivered by gravity at the city limits (7 miles) at the pressure now carried in the high-pressure pipes. This project is shown by Fig. 5.

The project has been investigated, and surveys and soundings show a favorable location for an intake (about ¾ mile above that of the St. Louis County Water Co.), at a point where the depth of water near the south bank of the river will admit of placing the intake tower so near the bank as to be connected with it by a bridge. The tunnel and shaft would be 9 ft. in diameter, with sufficient capacity for an ultimate supply of 200,000,000

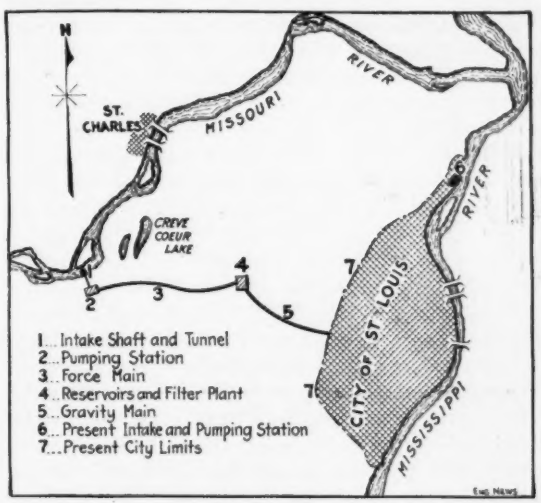


FIG. 5. PLAN OF PROPOSED NEW WATER-SUPPLY SYSTEM FROM THE MISSOURI RIVER, FOR ST. LOUIS, MO.

gal. daily. From the tower to the bluffs, where the pumping station would be located, the distance would be about ½ mile. From the pumping station to the reservoirs, 9 miles, there would be two steel mains 6½ ft. diameter, with provision for a future third main to give the full capacity of 200,000,000 gal. These would cost about $25 per ft. for each main.

The estimate of cost for this Missouri River supply system is given below. It is assumed that a working capacity of 100,000,000 gal. daily would be sufficient for many years.

	Capacity, 100,000,000 gal.	
	A	B
Land	$613,750	$463,000
Intake tunnel and tower	750,000	500,000
Bank protection	237,600	237,600
Pumping plant	1,500,000	1,450,000
Force mains	2,376,000	2,376,000
Settling basins	1,500,000	
Coagulating basins	350,000	3,250,000
Clearwater basins	1,000,000	
Filter plant	600,000	
Distribution mains, steel	2,032,800	2,032,800
Distribution mains, cast iron	1,013,760	700,000
A. Total, with provision for increase to 200,000,000 gal.	$11,973,910	.....
B. Total, without such provision	.....	$11,009,400

COST OF DOUBLING THE CAPACITY TO 200,000,000 GAL.

Pumping plant	$1,450,000	.....
Force main	1,088,000	.....
Reservoirs and filters	3,350,000	.....
Distribution mains, steel	1,016,400	.....
Distribution mains, cast iron	1,013,760	.....
Total	7,918,160	.....
Total cost for 200,000,000-gal. plant	$19,892,070	.....

With Missouri River water taken from this location it is probable that the cost of treatment (softening and filtering) would be materially less than that of treating the Mississippi water. The former is somewhat higher in scale-making elements, but owing to the direction of the currents below the mouth of the Missouri, much of the water now taken at the present intake is Missouri River water.

The reservoirs for a working capacity of 100,000,000 gal. would include a set of preliminary settling basins holding 200,000,000 gal., a pair of coagulating basins holding 1,500,000 gal. each, and clear-water basins having a total capacity of not less than 100,000,000 gal. The filter plant would consist of not less than 30 units, each of 5,000,000 gal. daily capacity. From this plant, two 7-ft. steel mains ($27.50 per ft. for each main) would extend to the city limits, beyond which 48-in. cast-iron mains ($16 per ft.) would connect with the present distribution system.

Creosoting Paving Blocks in Vertical Cylinders

Treating timber in vertical cylinders or retorts, instead of in the usual horizontal cylinders, is a feature of a new plant for treating wood paving blocks which has been patented by J. B. Card and Frank McArdle, of Chicago, and built by the Chicago Creosoting Co., at Terre Haute, Ind., during 1913. In a paper read at the annual meeting of the American Wood Preservers Association, Mr. Card stated that the plant has demonstrated its ability to treat the blocks at much lower cost than with the horizontal cylinder.

There are two tanks 11 ft. diameter and 14 ft. high, room being left for a third tank. They are made from ¾-in. steel plates butt-strapped inside and out, the bottom being on a slant of about 45°, with a 4-ft. door at the low point. The tanks are supported by a structural steel tower, the top of the tanks being 38 ft. above the ground.

The object was not only to reduce the cost of treating blocks, but also to separate the tie-treating work from the block-treating work, as it is a hard problem to deliver ties and blocks at the same time and keep everyone satisfied. In this case the tie plant furnishes the power for the block plant and both can run at full capacity and not interfere with each other. Each tank has a capacity of 400 yd. of 3½-in. blocks.

The blocks from the saw are delivered to a V-shaped trough, and carried to the top of the tanks by a cable conveyor running in this trough with 8-in. plates bolted to the cable every 4 ft. In dropping the blocks into the tanks, a small amount of oil is run into the tank until 3 or 4 yd. of blocks fall in, when the oil is run out and the tank allowed to fill. Blocks falling on top of one another are not injured in any way. It is not necessary to pay any attention to the tanks when filling. The tank will load solid to the top without any placing of blocks. When one tank is filled the trap in the conveyor is opened to the second tank. The work of the block mill is continuous, there being no stops in this case for switching of tram cars, etc.

The temperature of the solution is maintained by a large drum full of steam coils outside of the tank, it being heated and circulated at the same time. A tank will empty itself into a car in 2½ min., and in less than five minutes it is ready to be filled again.

Why Fast Freight Service is Expensive—"A fast freight train of 50 cars—and that is a good sized fast freight—will not average more than six revenue tons per car, or a revenue train load of 300 tons, about one-half the average. The Ohio Division, which carries about 23 cars in a fast freight, averages a revenue train load on fast freight of less than 150 tons."—R. N. Begien, Gen. Supt., Baltimore & Ohio Southwestern R.R.

Highway and Street-Railway Tunnels in San Francisco

By L. E. Torrey*

On account of the very heavy grades which exist in many parts of the city of San Francisco, Calif., street-railway and highway tunnels carrying the lines of streets under the hills have been under consideration for some time. Several articles in Engineering News in the past have described different projects, but it has only been within the past few months that active work has started on any one tunnel. At present in San Francisco one highway tunnel is under construction and two street-railway tunnels have been designed, one of which will probably be started soon.

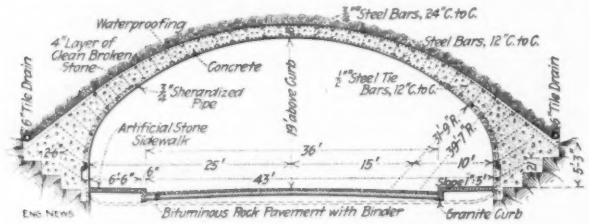


Fig. 1. Typical Section through Stockton St. Tunnel, San Francisco

These three tunnels are the Stockton St. tunnel, the Twin Peaks tunnel, and the Fillmore St. tunnel. The Stockton St. tunnel is located at the north part of the city and will open a connection between the business district and the North Beach district and will be one of the future communications to the 1915 exposition. The Fillmore St. tunnel is also at the north end of the city, but west of Stockton St., and also will open a way to the exposition, if it is decided to build this now. The Twin Peaks tunnel is in the center of the city and carries Market St. under the hills known as Twin Peaks.

downtown districts to the outlying residence districts to the southwest. The Fillmore St. tunnel, while it is reasonably certain that it will be constructed during the tunnel activity, is not yet advanced to a degree that will admit of discussion. The Stockton St. tunnel is under construction as noted below, and the Twin Peaks tunnel is to be taken up quite soon. The funds in each case are to be raised by property assessments, which are to be levied in proportion to the theoretical benefit that will accrue to each owner. As is usual in such cases, the courts have been resorted to to test the legality of the proceedings.

Stockton Street Tunnel

The Stockton St. tunnel is on the line of Stockton St. between Sutter and Sacramento Sts., a distance of 900 ft. It will have the effect of relieving the congestion on Kearney St. and Montgomery St. and providing a route through the less congested retail district to the section known as North Beach. No difficult prospecting was necessary to determine the nature of the ground through which the tunnel was to be driven because the 1906 fire had swept the hill clean and there is still sufficient open ground where the formation can be determined.

The tunnel is to be put through the hill for the entire width of the street, and no provision is to be made for surface traffic over the hill. This is made possible by the fact that the south slope of the hill is so steep that very few teams ever tried to negotiate it either up or down.

The tunnel, as shown in Fig. 1, is of elliptical reinforced-concrete arch section with a 50-ft. clear span and a rise of 19 ft. above curb level. There is provided a roadway of 36 ft. and two sidewalks, each 7 ft. wide. The details of the construction and of the reinforcement are shown in the figure. It is to be waterproofed on the outside and backed up with loose broken stone so that the drainage will be free to the side tile drains which will

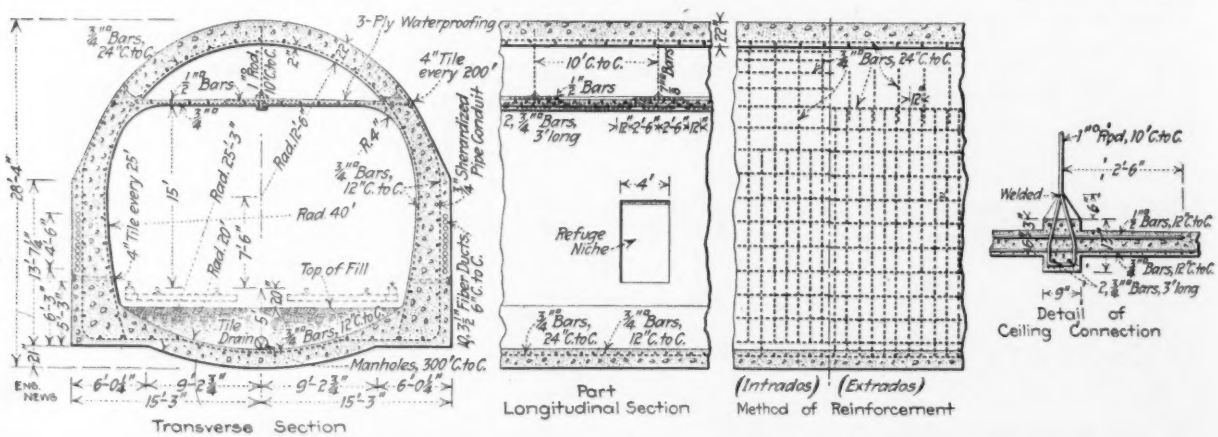


Fig. 2. Typical Section through Twin Peaks Market St. Tunnel, San Francisco

The Stockton St. and Fillmore St. tunnels are not to be used for the present at least by street cars. It is intended that in the future the municipal street-car system, the extension to which was authorized in the special election of Aug. 26, 1913, will make use of the Stockton St. tunnel. The Twin Peaks tunnel is to be used exclusively by electric cars to afford rapid transit from the drain to a center drain running under the roadway of the tunnel. The interior surface is to be of concrete plaster. The contract price is $337,000 complete without wiring or fixtures, which latter will amount to about $375 per lin.ft. About 2100 cu.yd. of concrete and 450 tons of steel are to be used in the construction.

The tunnel was begun on June 1, 1913, and on Jan. 1, 1914, was about 30% completed. The total length

*853 Church St., San Francisco, Calif.

twen portals is 911 ft., the bore proper being 730 ft. on account of the open cuts at the portals. There is a uniform grade of 4.29%. It is being driven from three headings, which are to be stoped between to place the forms for the concrete arch. When the entire length has thus been arched the core will be removed by the steam shovel. On Jan. 1, the three headings were, respectively, 629 ft., 392 ft. and 656 ft. of the total 730 ft. Of this length 111 ft. had been concreted from the south end of the tunnel.

Twin Peaks Tunnel

The Twin Peaks tunnel is to be exclusively used for electric street cars, and will be provided with two tracks and two sidewalks somewhat above the grade of the track, making a section similar to the station section of rapid transit subways. The tracks are to be provided with a third rail and the cars which operate therein will have a third-rail shoe in addition to the trolley pole. The tunnel will enter the Twin Peaks at the westerly end of Market St. and extend southwesterly on the line of that street at a grade of 3% to the summit, then drop at a grade of 1.15% to its western terminus near Sloat Boulevard. The total length is to be about 13,000 ft.

A very complete prospect of the formation through which it is to pass has been made. From the test holes which were sunk it was found that the formation through which the tunnel passed is extremely variable. On this account the section has been varied to meet the particular earth condition expected at different locations. In general, the tunnel is to be of reinforced concrete of approximately the circular cross-section shown in Fig. 2. The thickness of the arch at the top varies somewhat with the formation, and where the tunnel will rest on rock the entire lower arch below the rails is dispensed with. One section of about 1600-ft. length is to be rectangular; in the middle of the length the earth cover is so light that a part will be carried on as cut-and-cover work.

The tunnel is to be ventilated from two ventilating stations, one near each of the portals. These stations will make a complete change of air every 20 min., which will require the fans to supply about 146,000 cu.ft. of air per min. This air will be forced into the air passage which occupies the dome of the section and will filter through louvers at regular intervals. This upper air space is provided in the elliptical section by a hanging ceiling, shown in Fig. 2, but in the square section there will be no special air passage, the section being ventilated only as it serves for the outlet of the air from the arch section. The ceiling shown in Fig. 2 is a thin concrete slab, reinforced with bars, which rests on a concrete beam hung at intervals by steel rods to the arch section above.

This tunnel is so long that it requires two intermediate subway stations, one called the Eureka Valley station near the Market St. entrance, and one Laguna Honda station about 3000 ft. from the western portal. The former will be in the rectangular or flat-top section, and access to it will be had by stairs exclusively. The latter will be of more elaborate construction, being provided with elevators and stairs.

The cost of the tunnel complete will be about $4,000,000, or $300 per foot. As before stated, the tunnel is being built for electric cars exclusively, but whether privately owned railroads will use it or the municipal railroad is yet an open question. The idea seems to be to build the tunnel and then if the city is not prepared to use it, for the municipal road to lease it or rent it by the year to a private company. At present there seems to be no definite plan, but it is probable that by the time it is ready for use the city will have a definite municipal system laid out looking toward the use of the tunnel.

The tunnel construction is under the jurisdiction of the Board of Public Works. The plans were prepared by M. M. O'Shaughnessy, City Engineer, and the assistant engineer in charge is Geo. J. Couchot.

Important Improvement Work on the Baltimore & Ohio R.R.*

By Francis Lee Stuart†

We have in Chicago 90 miles of railroad, mostly within the city limits. We are spending a great deal of money in Chicago, mostly for the elimination of grade crossings; whether the division of that expense is a proper one for the railroads to bear or not is a question, but for the growth of Chicago, it is the right thing. They need it.

On the Chicago Division, in the last few years, we have double-tracked all except 25 miles of the 278 miles, and the road is one of the best workable stretches of railroad on our system. At Chicago Junction we put in a yard recently that holds about 7000 cars. That was a necessity to make classification for delivery to our various connections and also to prepare for Chicago deliveries.

Next in line comes the New Castle Division, which is also a low grade division, and in good shape. There is still a section of bad grade around Akron which is under consideration. In the city of Akron we badly need team tracks, freight house facilities and industrial connections.

The Pittsburgh Division is one of our most serious problems. There we have heavy grades and many other things to meet and cope with. Our track from Sewickley to Glenwood is a crooked one, and the expenditure which we will have to make between these points is so great that we have been deferring it. We will soon have to build a bridge across the Allegheny River which will cost $2,500,000, in addition to our large expenditures in Pittsburgh.

From Connellsville to Cumberland, we have a fine railroad over the Allegheny Mountains. At Somerset we have built a new yard, and a low-grade line from Rockwood to Garrett, and have opened up Sand Patch, which was a difficult problem to handle, by building a new double track tunnel so that we will be able to handle about 1500 cars over the mountain eastbound.

Between Cumberland and Grafton, we have in recent years almost rebuilt a railroad—built yards at Grafton and Keyser, helper stations, third tracks, reduced lengths of helper grades, made open cuts of tunnels, and have three tracks in tunnels at Kingwood in place of one.

On the Cumberland Division, the north and south avenues come together in Cumberland and disgorge all their freight between Patterson Creek and Cherry Run. That is one of the densest pieces of railroad in the country. We have at times 2500 loaded cars eastbound a day. We hope we will have 4000. We are gradually preparing to handle it if we can get it. The prosperity of the Baltimore & Ohio Railroad and of West Virginia and other sections depends on our being able to take care of the business here as it grows.

We have added third tracks and built a yard at Cumbo, and we have now undertaken the biggest expenditure on the Baltimore & Ohio Railroad, that is, to open the neck of the bottle at the Magnolia Cut-off. On eleven miles there we will spend $6,000,000 for two additional tracks, which takes out the Hansrote helper grade and makes possible the reduction of the ruling grade of the division, and saves 5.8 miles in distance.

It has in constructive lines about all the problems which you could imagine. At the west end, where the four tracks are at the same grade, and along the river bank, the river has the narrowest waterway for miles on either side, and we have to build a masonry retaining wall 24 ft. high, to protect our banks. We have tunnels on tangent and tunnels on curves. We have bridges at right angles and bridges on skews. We are taking out the present Doe Gully tunnel, under traffic, and making a four-track open cut. We have three sections with rock bluffs alongside of our railroad from

*Extracts from an address before the B. & O. System officers at Deer Park, Md.

†Chief Engineer Baltimore & Ohio R.R., Baltimore, Md.

80 to 100 ft. high and we have to take them down without interfering with traffic in any way. At danger points we are using every safeguard of which we know, and are safeguarding our road in a way that has never been done by any railroad in this country. We are spending money to do it.

I will tell you something that might interest you about our blasting. We have men down on the tracks; we have an operator near the holes and fire by dispatcher's order, and have two flagmen and an inspector of the blasting who inspects every hole, sees how much dynamite is put in and uses his best judgment. These are old men in the business but, of course, they sometimes fail. Some days—as often as for ten days in succession—we make successful shots and just shake up the rock, and then comes a day when the bottom will fly out and down on our tracks and occasionally causes delay.

At Brunswick we have put in a westbound fast freight classification yard. As on the lakes, one of our difficulties on the Baltimore Division is the holding of loads for full cargoes for boats. We used to hold the loads at Brunswick and it congested traffic, so we have added 900 cars capacity to our Curtis Bay Yard at the head of the coal pier. We are considering building another pier there. We need such a pier, not only to handle the increase in our business but as a fire insurance and safety precaution. We have excellent facilities in Baltimore, but we are having difficulty to keep pace with the growth of business and get our traffic for the east through the city.

In Philadelphia we are facing quite a serious proposition. The city claims our line across the city to the Delaware River front is an actual barrier to the progress of the city, and we are making arrangements with the city to elevate our road and move down along the waterfront, and we will have the situation in very good shape within a reasonable time. But—it costs money. At Staten Island we have added somewhat to our capacity for business. We have a new covered pier and we had our bulkhead line changed and pushed out, and we now own over 4000 feet of waterfront on the Arthur Kill for future developments when St. George becomes congested. Over in Manhattan we have leased an additional freight pier near Brooklyn Bridge and have bought a whole square, which we previously leased, at 26th St. and 11th Ave., and are putting up an 8-story concrete warehouse on the site now, which will be modern and uptodate in every respect, and we think it is going to bring us business.

Now, while we have been adding necessary facilities and improvements, we have bought heavier motive power—Pacific type passenger engines and Mikados and Mallets for freight—and strengthened our bridges and tracks. Where used, this alone, measured by standards of the old engines, increased the capacity of our railroad by cutting out 6 out of every 30 freight trains, and in effect cut 1% grades to 0.8%, 0.5% to 0.37% and 0.3% to 0.2%.

The concrete result of the expenditures which we have made for improvements, additional facilities, heavier and better equipment—the result of our thought, our hard work, our continual drive, is that we have lately, at times, handled business at the rate of $112,000,000 gross per year, and can keep it up; a thing that would have been impossible three years ago.

The Baltimore & Ohio's problem is not to find business. We cannot handle all that is offered to us now, and I know that is one of the great problems we must face in the future. In my opinion—after improving our efficiency—after largely increasing our facilities in general—after judiciously spending $83,000,000 in the last three years to better our condition—our needs are so great that we are not only not keeping up with the legitimate growth of business in our territory, but are falling behind. In fact, the entire country today faces a grave and serious condition in the present relationship between the amount of business which the country is now offering and the additional facilities which the railroads must have to handle it, so as not to stop the normal growth of that business.

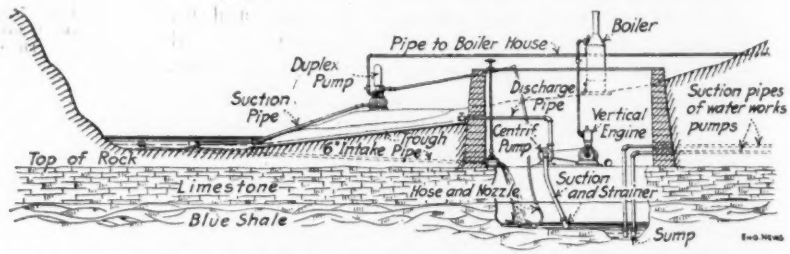
A Joint Sewage-Treatment Plant for Youngstown, Girard, Niles and Warren, Ohio, was suggested by W. H. Dittoe, chief engineer of the Ohio State Board of Health, in a recent conference with the city officials of Youngstown. The sewage of the cities named would be diverted from the Mahoning River to a point below Youngstown. Legislation would be required before the acts suggested could be undertaken.

Cleaning a Water-Works Intake Well at Florence, Kan.

By H. M. Plaisted*

The definition of dirt as "matter out of place" was well illustrated recently in the case of the intake well of the water-works at Florence, Kan., the well having become so choked with deposit that special means were required to clean it out. The deposits of 15 years had been increased by débris from freshets of the stream on the bank of which the well was located, which freshets annually washed a layer of Kansas soil upon and through the flat board cover and once broke in the stone wall itself. The accompanying section shows the well and the cleaning plant. The well was located on the east bank, near the boiler and pump house, which were higher up on the bank. The water was pumped to a standpipe 7 ft. inside diameter and 55 ft. high.

The stream is normally 2 ft. deep and 50 ft. wide, flowing at the bottom of a gulch 30 ft. or more deep, with its sandy bed supported on a limestone stratum 8 ft.



Sectional Elevation of Intake Well, Showing Arrangement of Plant for Cleaning Out the Mud Deposit

thick. The well was formed by blasting an irregular hole, 28x34 ft., through this rock and 7 ft. further into the blue shale below. The rock was used to build a circular wall 45 ft. outside diameter, and 24 ft. above the rock stratum. The top of the well was 5 to 10 ft. above the sloping bank, 18 ft. above the stream and 39 ft. above the bottom of the pit. A sump hole 3 ft. deeper, for the pump suctions, was located at one side, as shown in Fig. 2.

When the well or rectangular pit was pumped out it was filled with rich black mud to an average depth of 9 ft. This mud was found to be sludge that would not bear the weight of a man but was too thick to pump, and its surface was about 30 ft. from the top of the well.

The circular wall as built on the rock stratum provided a ledge 5 ft. wide at one side of the well and 24 ft. from the top. Upon this ledge was lowered a 6-in. centrifugal sand pump and a 10-hp. vertical engine which were bolted to timbers laid on the ledge. The suction pipe thus had no more than 17 ft. lift, till the bottom was reached and the strainer was placed in the sump hole. A hole was cut through the wall, 10 ft. above the pump, for the discharge pipe. This pipe delivered into a sluice-box or trough leading to the stream at a point below the intake for the well. A vertical boiler furnished steam at 100 lb. pressure to the engine, which drove the pump by a 6-in. belt from a 30-in. to a 12-in. pulley.

As it was necessary to thin the mud to pump it, a 2½-

*Mechanical Engineer, 2156 C St., Granite City, Ill.

in. fire hose was led into the well, with a 1⅛-in. nozzle playpipe, which was directed by a man standing on planks. It was found necessary also to have a man oscillate continually the strainer end of the pump suction. To supplement the hose stream, a 6-in. auxiliary water line from a plug in the stream was opened and regulated as required. The water for the fire hose was supplied by a duplex pump, mounted on the river bank and taking water from the stream through a 4-in. pipe. Steam was supplied to this by a temporary line from the boilers of the water-works.

Little difficulty was experienced in breaking up the mud with the hose stream, or in pumping, as long as the "soup" around the strainer was kept thin by frequently stirring it with the hose. The centrifugal pump would pass rocks, pieces of shale, etc., but would balk at chunks of mud and sticks, and once refused to take out a length of ¾-in. rope that had been lost in the mud.

For removing the last 2 ft. of the deposit, a derrick was rigged and two buckets of 3 cu.ft. capacity each were hauled up alternately by a horse, with two-ply tackle. The lowest mud was tenacious like "gumbo," and was difficult to remove even with shovels. With two men filling the buckets and two dumping, the maximum rate was 3 cu.yd. per hour at a cost of 50c. per yd. When the buckets were taken to the far side of the pit, this cost rose to 80c. per yd. This work went on while the pump and hose were operating on the other side of the pit, and saved two days' time.

The total time of cleaning after the pumps and engine were started was seven days, and about 340 cu.yd. of mud, shale and rock were removed. The work was done under the supervision of engineers David Lofts and H. M. Plaisted, with machinery rented from the Contractors' Machinery Co., of Kansas City, Kan.

Concrete Sewer Pipe at Kansas City, Mo.

Reinforced-concrete sewer pipe 30- and 33-in. diameter, and plain concrete sewer pipe 10- to 24-in. diameter, are in use at Kansas City, Mo., costing $1.50 and $1.90 per ft. for the former and 17c. to $1.06 per ft. for the latter. Plain concrete pipe up to 12-in. diameter is of cement and sand 1:2½. Larger pipe may be of the same mixture, or of 1 cement, 1 sand and 2 stone. The thickness is from ¾ in. for 6-in. pipe to 2 in. for 24-in. pipe. The crushing strength is from 1000 lb. per lin.ft. for the smaller to 2000 lb. for the larger size, and in the hydrostatic test the untreated pipe must show no percolation up to 10 lb. per sq.in. and shall resist fracture at 33 lb. per sq.in. internal pressure.

These particulars are summarized from a paper by E. S. Wallace, Cement Inspector, Kansas City, Mo., presented at the annual meeting of the Illinois Society of Engineers and Surveyors, at Peoria, Ill., Jan. 28-30. The hydrostatic test was described by Mr. Wallace in ENGINEERING NEWS, Mar. 20, 1913, and the conclusions presented in the above paper are as follows:

Our tests have shown conclusively that there are three things essential to the manufacture of good concrete pipe: 1, the pipe must be composed of proper materials; 2, it must be made right, and 3, it must be cured right. Too much emphasis cannot be placed on the fact that curing is as essential as the materials from which the pipe is made, or the method of manufacturing, for it is possible for a manufacturer to exercise all the care possible in the first two matters and ruin the output of his plant by improper curing.

After the molds have been removed the finished pipe should be kept thoroughly moist and at a temperature of about 70° F. for at least 10 days, and in extremely hot or cold weather it should not be exposed to the elements for a much longer period.

During the winter of 1912-13 considerable difficulty was experienced on account of improper curing. The storage sheds were heated with stoves, and pipe placed too near them dried too rapidly while those near the sides of the shed were retarded in setting on account of the cold. It was expected that when warmer weather arrived this difficulty would be overcome, and this was the case to some extent until the extreme dry hot weather came. Then, as the storage capacity was inadequate, large numbers of pipe were placed in the yard, exposed to the air and sunshine, before they were properly cured. This was found to be as great (if not a greater) detriment than the cold weather.

The writer has made experimental tests on a number of 8-in. 10-in. and 12-in. pipe of 10 days age, that were properly cured up to that time, which have resisted from 60 lb. to 90 lb. internal pressure without showing any signs of seepage or percolation. Pipe of the same size and made under the same conditions, and of much greater age, but which had been stored in the open and exposed to the elements, have repeatedly failed below the specification requirements. The manufacturers of these pipes use no waterproofing, and hundreds of tests have demonstrated that none is required where materials are carefully selected and proper care is exercised in manufacturing and curing.

During the year we have made 530 tests on concrete pipe ranging in size from 8-in. to 24-in., 411 (or 77.55%) of which passed both percolation and pressure tests. This does not represent the percentage of loss of the output of the plant, as most of the failures occurred during July, August and September, when the weather was extremely dry and hot. Under weather conditions such as existed in the spring and late fall, this loss would probably be reduced about 50%. Of the 411 pipe which passed, 99 resisted pressures ranging from 34 lb. to 106 lb.

We have practically abandoned the compression tests, as we have never found a pipe of either clay or concrete that failed below specification requirements. There is but little difficulty experienced in handling concrete pipes, as they are not brittle and resist considerable impact before fracturing.

The pipes are made on a machine having four revolving tamping bars, eccentrically worked and striking 300-lb. blows at 150 blows per minute. The core works on a revolving screw and remains stationary during the tamping; then it is started and after making a sufficient number of turns to trowel the interior, it drops below the floor. This troweling of the interior is important and when the pipe is properly made it has the smooth glazed finish desirable for sewer work. The concrete is a dry mix, fed from an overhead bin through a 3-in. pipe and deposited directly in front of the tampers.

The finished pipe is taken to the curing shed, where it is placed on end and the mold is removed. It is strong enough to stand without allowing additional time for the cement to set. It is kept moist for about ten days before being removed to the storage yard. The concrete is of a consistency that will barely hold together when pressed firmly in the hand, and after the molds are removed the "water web marks" show plainly over the exterior. Our tests have demonstrated that when the mix is so dry that these marks do not show, the pipes show seepage or percolation on test and usually fail at a low pressure.

In 1912, Kansas City laid over 35,000 lin.ft. of plain concrete pipe, and in 1913 over 75,000 lin.ft. in sizes ranging from 8 in. to 24 in. There have been no failures. The pipes were manufactured by the Kansas City Concrete Pipe Co.

Aërial Propellers for Canal Barges have been tried on a test boat in the Surrey Canal in London, Eng. On Dec. 18-19, 1913, an 80-ton barge about 14 ft. wide, and equipped with an aërial propeller 8 ft. 3 in. in diameter, arranged to be driven at 700 r.p.m. by a motor running at 900 r.p.m. was tested. The speed of the propeller actually obtained was, however, only 500 r.p.m., but at this the unloaded barge was moved at the rate of four miles per hour. When a low bridge was passed the propeller had to be lowered in a plane perpendicular to the direction of motion. It was found, as had been discovered in the laboratory, that during this time of movement by the propellers the thrust was notably increased with the result that the barge gathered speed and could move forward unpropelled for a greater distance than would otherwise be the case. It was shown that an aërially propelled barge did not impede the other canal traffic and that two such barges would, when passing, exert little if any action on each other.—"The Engineer," London.

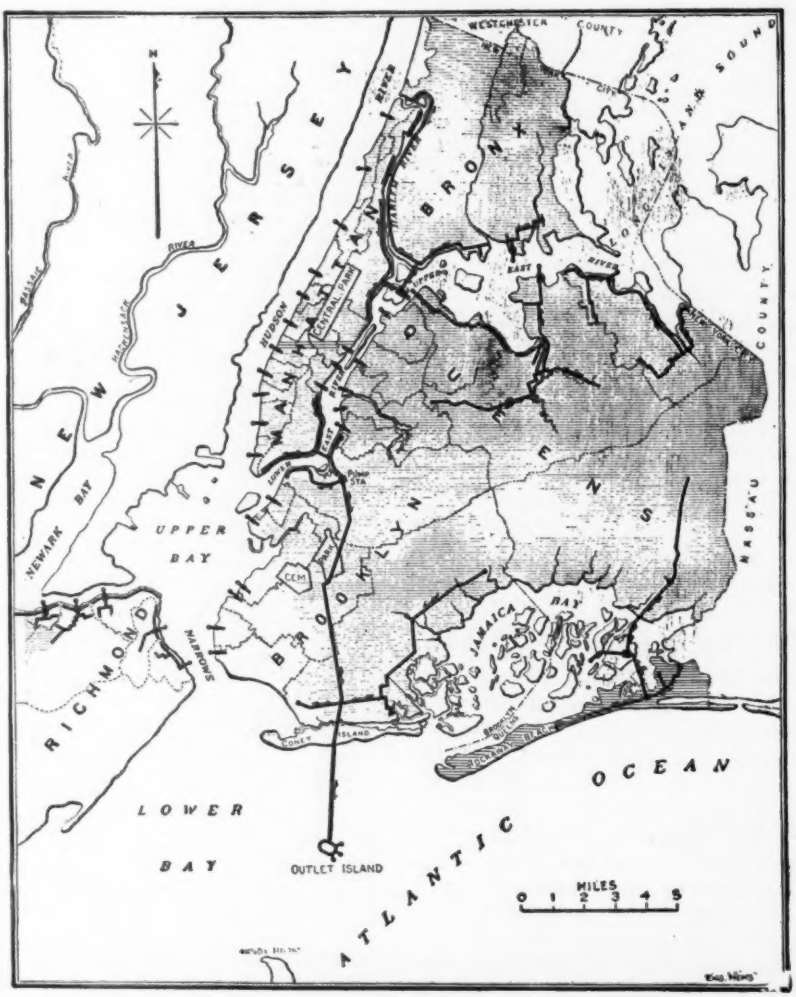
A Comprehensive Sewage-Disposal Project for New York City

The comprehensive sewage-disposal project worked up with great care by the Metropolitan Sewerage Commission of New York,* during the past few years, is graphically shown by the accompanying map. The project has just been brought to the front by the announcement that the commission has nearly completed its final report; that the members of the commission have sent their resignations to Mayor Mitchel, to take effect when the final report is filed, not later than April 30; and by the accompanying recommendation of the commission that a new commission be created to carry out the plans devised by the present commission.

The most striking feature of the whole project is the proposed creation of a sewage-disposal island in the Atlantic Ocean, three miles out to sea from Coney Island. To this island there would be conveyed by a tunnel the sewage which is now discharged into the Lower East River from the east side of lower Manhattan and from a part of Brooklyn, and also most of the sewage of the remaining part of Brooklyn. Later on, the sewage from some other large areas would also be conveyed to the island, but not until the proposed sewage-treatment plants at Ward's Island and in Jamaica Bay (see map) were no longer able to prevent the overburdening of the waters receiving the effluent of these two plants.

Besides the three sewage-treatment plants just mentioned, there would be numerous screening and grit chamber stations along those portions of the water front of the city which are not included in the three large districts named, and five screening and sedimentation plants on the north shore of Staten Island (Richmond Borough), all as shown on the map.

It is estimated that in 1915, the population tributary to the sewage-island plant would be 1,412,000 and that the corresponding dry-weather sewage-flow would be 203,000,000 gal. The sewage would have to be pumped under a static head of 45 ft. through 11.8 miles of conduit, mostly in tunnel, to the sewage island. The internal diameter of the conduit would be 12 ft. 10 in. from the pumping station to a point near Sheepshead Bay and 14 ft. from there to the Island. The 14-ft. portion of the tunnel would be driven through sand at a depth of about 60 ft.



MAIN COLLECTING SEWERS AND SEWAGE OUTLETS, PROPOSED BY THE METROPOLITAN SEWERAGE COMMISSION OF NEW YORK

The island would be about 1000 x 1300 ft., with its surface about 18 ft. above mean low water. The water depth within a mile of the site chosen for the island is from 7 to 40 ft., averaging about 20 ft. at mean low tide. It is proposed to form the island by building a riprap wall of 3 to 1 slope on the side next the sea, and about 2 to 1 on the inner side, and filling the enclosure with excavation wastes from the city and with sand dredged or pumped from the vicinity. A breakwater on the land side of the island would afford shelter for supply boats and for sludge-removal boats.

The sewage coming to the island would all have passed through screens and grit chambers at the original main collecting points. On the island it would be settled for about two hours, probably in modified Dortmund tanks.

The estimated first cost of the island disposal project was placed at about $23,000,000 a year ago, but we are informed by Geo. W. Soper, President of the Commission, that this is "much larger" than the latest estimates of the commission. We are also informed by Mr. Soper that the total cost of the projects proposed by the com-

*The members of the commission are Geo. A. Soper, president; James H. Fuertes, secretary; H. de B. Parsons, Charles Sooysmith and Linsly R. Williams.

mission is less than $50,000,000 and that Mr. Watson's estimate of $100,000,000 (p. 33, Preliminary Report VII), "was apparently intended to refer to an ultimate expenditure which might not be incurred for fifty or even more years."

The outline here presented, except as modified in the preceding paragraph, is based on preliminary reports made by the commission in and prior to 1913, and may be modified in the commission's final report. The project, it may be added, was approved in two reports made in 1913, by Gilbert J. Fowler, of Manchester, England, and John D. Watson, of Birmingham, England, after a visit to this country for the purpose of studying the subject. A considerable number of other authorities on sewage treatment have been consulted by the commission during the past few years.

We are indebted to Mr. Soper for the following information regarding its final report:

The system of main drainage and sewage disposal which the commission will recommend in its final report, is intended for adoption by the city both as a plan and policy for future construction, and the commission recommends that it be carried out in successive steps and not as one undertaking. The immediate construction of the whole scheme is not necessary from a sanitary standpoint. Such parts of the system as are needed for the immediate future should be taken in hand at once and the remainder built as required. The plans will be sufficiently flexible and elastic to permit of indefinite extension and the adoption of any discoveries or improvements in the art of sewage disposal, which may be made in the future.

When complete, the works will constitute a systematic and well coördinated scheme of main drainage for the city, which will utilize the absorptive capacity of the harbor waters to the greatest extent consistent with due regard to the public health and welfare.

The final report will contain, in addition to the projects recommended for construction, a number of alternative plans for sewage disposal, which have been considered but not regarded as affording the best solution of the problem.

Throughout its work, the commission has followed the policy of inviting the best qualified experts obtainable to contribute criticism, both constructive and destructive, the intention being to make the investigations represent the broadest and most authoritative treatment of New York's sewage problem which could be obtained.

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Needed Reforms in Highway Bridge Construction*

BY H. A. RICE†

The advent of the automobile has created a great stimulus for good road building. The question is being agitated throughout the United States, and large sums of money are being appropriated for the purpose.

Intimately connected with good roads is the question of good permanent bridges. Without them good roads are impossible.

It is a question which involves a vast expenditure of money. Shall this money be wasted as in the past, on poor flimsy structures, a disgrace to the designers and a disgrace to the state, or shall we as engineers tackle the problem and solve it?

The responsibility rests with you as County Engineers. You are the men who are familiar with the present methods. You know that a large number of bridges being built in the state will not carry the loads that may come upon them. Why do we read every few days of bridge failures under the load of a traction engine? I know of bridges built not over three years ago, with concrete floors and supposed to be modern in every respect, which have failed under the load of a traction engine. Is there any excuse for such failures? Would any man design a bridge which would not carry a traction engine if he wanted to give value received? Why then do these failures occur, not occasionally, but frequently? Is it the fault of the county engineer? Usually not. Frequently he is not consulted in regard to a bridge. As I understand the law it is not necessary for the Commissioners to consult him.

Who then is responsible for our bridges? Three County Commissioners—one a grocer, one a farmer and another a politician—all men of ability in their line, but their line is not bridges. These men know absolutely nothing about the design of a bridge.

Contracts are let frequently without a drawing or anything to show what sort of a bridge is to be built. They usually fix on a price to be paid for a bridge, usually too small, the bridge is let and built. Maybe the County Engineer is consulted, but usually not. Everything is left to the honesty of the bridge company. Bridge companies are looking out for number one. Who is looking out for the county and the taxpayers?

Why do we hear the incessant cry of too much taxes? Lower the taxes. Because, for one reason, half of the money spent for roads and bridges in this state is wasted. How do I know? Because, as I have said, bridges which should last 25 to 30 years, are failing continually after three or four years' service.

The question then comes up: What is the matter with our system? It is easy to see that it is wrong, but what is the remedy?

NEED OF A STATE ENGINEER

I am thoroughly convinced that a State Engineer is needed, and that if the proper man is secured and given sufficient authority, the problem of good bridges in the state will be solved.

The question of the proper man for the position is an important one. As I see it he should be a man who fulfills the requirements of the following specifications:

First of all he should be a man with a bounteous supply of backbone, that is, a man who sees the right side of a thing and who has the moral courage to carry it out. He should be a man of wide experience and technical training in bridge work. By wide experience I do not mean a man who has worked as a draftsman for a year or so for a bridge company, but a man who has had not only drafting experience and shop experience, but one who is thoroughly familiar with all the ins and outs of bridge designing, bridge contracting and bridge construction. A man whose word is authority on any detail of bridge work. It is my opinion that all honest bridge companies would welcome the day when they could submit their plans to a competent engineer and know that they would receive fair consideration.

The salary of a State Engineer with the above qualifications would necessarily be large, but it would be a small consideration compared with the savings to the various counties, owing to properly designed bridges.

What should be the relation of the State Engineer to the County Engineer? The County Engineer should act in the capacity of assistant to the State Engineer and it should be his duty to superintend the erection of all bridges in the county. He should do all surveying, make borings and cross-sections which are to be furnished to bidders. The salary should be such as would secure competent men for the position. There should be some requirements as to qualifications which would exclude incompetent men. His office should be elective and he should not be an appointee of the County Commissioners.

The duties of the State Engineer would be chiefly in approving designs submitted by bidders, in establishing standard details, writing specifications, and in having general supervision over the erection of bridges. He should require drawings submitted for all proposed bridges of the state and should require detailed working drawings from the successful bidder. These should be checked with the original drawing submitted and if found correct should receive his approval. The County Surveyor should be furnished a copy of these working drawings and should check the material when it arrived for erection. The State Engineer should have final approval of the bridge before a warrant is drawn for its payment.

The duties of the State Engineer should be very similar to those of the Engineer for the State Board of Health. Those of you who are familiar with his duties know that no sewer systems, no waterworks or other sanitary construction can be installed in the state of Kansas without his approval. As a result of his supervision the sanitary conditions in the state are second to none in the United States.

This is not a new question but one which has been solved by many of the states. Many of our neighbor states have State Highway Commissions with State Engineers, and judging from inquiries which I have made, they are very successful.

*From a paper read at the annual meeting of the Kansas Engineering Society.

†Professor of Mechanics, University of Kansas.

The Depreciation Plan of the Valuation Committee of the American Society of Civil Engineers

The general conclusions of a report on valuation as a basis of public-utility rates, by the Valuation Committee of the American Society of Civil Engineers were printed in ENGINEERING NEWS, Jan. 29, 1914. The prominence of the members of the Committee* gave great weight to the recommendations. The findings themselves—except perhaps the parts on depreciation—have secured wide appreciation through their practicability and evident fairness to both utilities and the public.

The treatment of depreciation has not been universally appreciated and its true significance is not comprehended in a single reading. The Committee has received a large number of criticisms based on misconception of its methods. This situation is due in a measure to the abrupt manner of presentation of a novel scheme, in part to the complicated nature of the subject and in part also to the tendency for thought in such matters to run in familiar channels. However, the Committee's ingenious depreciation plan when truly seen presents a logical way of conforming to some hitherto troublesome requirements of the highest courts as regards return on depreciated value, sinking funds, etc., yet gives the investors their due return on the full investment at any period, gives more freedom of utility operation and leaves the rates as stable as ever.

When the Committee started its work it found several schemes in use for making depreciation allowances, none of which were entirely satisfactory. There was, for instance, reliance on an "actual-inspection" method employed at longer or shorter intervals but tending to burden the earnings erratically and causing a possible loss of investment through failure to recognize all elements of depreciation.

There was also a "replacement" scheme of depreciation provision in use, particularly in some railway work, where it was intended to keep up the full value of investment by repairs and replacement, which were direct burdens on earning. But this they found satisfactory in results only on unregulated properties where there was a multitude of short-lived items and also much extension and betterment paid out of gross earnings. Moreover, it secures the depreciation repayment on each item only when the life of such is ended, and therefore it is not widely applicable where there are fewer duplicate and long-lived property items.

Perhaps the most popular depreciation scheme was the "sinking-fund" plan by which such annual sums were placed in the rates as would, with accumulated interest, equal the cost of each item at the end of its useful life. The objection to this was that the aggregate depreciation allowance for any item was not really paid back to the utility until the item's life was ended. The annual sums have sometimes been put into a true sinking fund, but more often are turned into the working funds of the utility where they earn the necessary interest just the same. The rates for equity then always would have to be based on full reasonable investment, rather than on the depreciated value of the time. But the highest courts have consistently held, as in the Knoxville case decision of the U. S. Supreme Court, that rates should be based on present value, which would be investment less depreciation and plus appreciation. There are many decisions denying the propriety of a corporation's establishing, actually or in effect, a sinking fund which has to be kept intact for a long term of years to serve its intended function of repaying depreciation.

There was to be seen one scheme of making depreciation allowances which in a way answered the two legal requirements mentioned. This was the "straight-line" method in which the annual depreciation burden on rates was the cost of an item divided by the expected life. This was a full return of impaired security for the investors and on being reinvested in the plant kept the actual value of the moment equal and even greater than the investment. It did more: the depreciation payments in the earlier years were heavier than the depreciation, and the rates were excessively burdened at a time when the business was least developed. Moreover, the rates to be reasonable would be decreasing each year because of the diminishing interest charge. This distortion of the reasonable rate rendered the scheme difficult of application.

The American Society Committee decided to arrange a scheme resembling the "straight line" in so far as the sum of all the depreciation allowances for an item during its life should equal the cost of the item, but differing from the "straight-line" scheme in being proportioned so as to be smaller in the earlier years and larger in the later years. It was found advisable, in order to promote stability of rates, to make this annual depreciation allowance such that it, plus interest on the unrepaid investment, should be a constant sum. This they could do by making the first annual allowance numerically equal to the annual allowance by the sinking-fund method—a method by which equal annual contributions to the sinking fund, with accumulations of interest, would equal the cost of the item at the end of its life. That sum was not to be considered in any way held in a reserve, but a direct repayment for impaired security of the utility available for retirement of obligations or, what was equivalent, for reinvestment in replacements, additions, improvements, etc. The second year's depreciation allowance would be numerically equal to the preceding sum plus a year's interest on that allowance. Each year's allowance was similarly figured as the first year's sum plus the interest which would have accumulated on a sinking fund during the year. Thus, in effect the customers paid the equivalent of the interest which the preceding allowance would have had to earn under the sinking-fund scheme. But this was compensated by the decreasing annual interest on original investment. Any replacements, extensions, etc., increased the figure for investment and worked out fairly for the utility.

After such explanations, the report may be better understood. Extracts from the report follow:

EQUAL-ANNUAL-PAYMENT METHOD—In practice it is not feasible to comply exactly with the theory stated, but it can be so nearly complied with that the Committee has called the method which it recommends an Equal-Annual-Payment Method.

In order to explain the Equal-Annual-Payment Method the accompanying illustrative table is presented, but the table takes into account only the two principal of the three factors involved, namely: (a) the annual depreciation allowance,

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ILLUSTRATION OF EQUAL-ANNUAL-PAYMENT METHOD OF COMPUTING DEPRECIATION

Assumptions: Property having 20-year Life valued when new at $100. Depreciation Allowances so arranged that total is $100, and each is 5% larger than the preceding. Annual Return on Capital Invested 5 and 7%.

(1)	(2)	(3)	(4)	(5)	(6)	(7)
			Return on remaining value of property at:		Combined depreciation and return upon investment at:	
Age, in years	Value at end of year	Depreciation during year	5%	7%	5%	7%
0	$100.00					
		$3.02	$5.00	$7.00	$8.02	$10.02
1	96.98	3.18	4.84	6.79	8.02	9.97
2	93.80	3.33	4.69	6.57	8.02	9.90
3	90.47	3.50	4.52	6.33	8.02	9.83
4	86.97	3.68	4.34	6.08	8.02	9.76
5	83.29	3.86	4.16	5.83	8.02	9.69
6	79.43	4.05	3.97	5.56	8.02	9.61
7	75.38	4.26	3.76	5.27	8.02	9.53
8	71.12	4.47	3.55	4.98	8.02	9.45
9	66.65	4.69	3.33	4.67	8.02	9.36
10	61.96	4.93	3.09	4.33	8.02	9.26
11	57.03	5.17	2.85	3.99	8.02	9.16
12	51.86	5.43	2.59	3.63	8.02	9.06
13	46.43	5.70	2.32	3.25	8.02	8.95
14	40.73	5.99	2.03	2.85	8.02	8.84
15	34.74	6.29	1.73	2.43	8.02	8.72
16	28.45	6.60	1.42	1.99	8.02	8.59
17	21.85	6.93	1.09	1.53	8.02	8.46
18	14.92	7.28	0.74	1.04	8.02	8.32
19	7.64	7.64	0.38	0.53	8.02	8.17
20	0.00					
		$100.00				

(b) the return for the use of capital, and omits (c) the minor effect of the cost of repairs and operation which will be referred to subsequently.

When the annual return for the use of the capital invested is based upon the same percentage that is used in computing the depreciation, the method provides exactly the same total payments on account of depreciation and return combined as would be obtained by establishing a sinking fund which earned 5% interest, but it does not contemplate the maintenance of such a fund. Thus, at 5% the annual contribution to a sinking fund to wipe out $100 of value in twenty years is $3.02, which, added to 5% return on the $100 originally invested in the item of property, gives a total of $8.02 for each year.

It will be seen by reference to Column 6 of the table that $8.02 is the combined annual depreciation and return for each year of the twenty by the proposed method, but this sum in the table is made up in a different way. The annual return, instead of being based upon the full value of the property, is based upon its net or depreciated value at the beginning of each year, as given in Column 2, such net value being obtained by subtracting successively the depreciation during each year. For example, the depreciation during the first year is $3.02, which subtracted from the full value leaves $96.98 as the depreciated value at the end of the first year; deducting from this figure the depreciation during the second year, amounting to $3.18, leaves $93.80 as the depreciated value at the end of the second year, and so on.

The return for the use of capital in the third year would be 5% on $93.80 (the depreciated value at the beginning of the year) equal to $4.69 as stated in Column 4, which, added to the $3.33 for depreciation during the year, gives $8.02, as stated in Column 6.

The Equal-Annual-Payment Method distinguishes plainly between the return for use of capital, available for dividends, and the depreciation allowance which should be credited to the capital account; thus in the tenth year of the item of property illustrated in the table, the return available for dividends is $3.09, as given in Column 4, while the depreciation allowance to be credited to capital is $4.93, as given in Column 3.

The method is an advantageous one for valuing an old property because the rates remain the same regardless of the ages of the several items of property.

Attention may be called to another feature illustrated by the table. If the item of property having a twenty-year life has existed for say twelve years, its depreciated value at the end of the year, as given in Column 2, is $51.86, and the depreciation allowance for the thirteenth year is $5.43. This allowance is the same amount as an annual sinking-fund payment on a new item of property having a value of $51.86 and a life of eight years.

The foregoing statements have been based on the use of 5% in all computations, but there are reasons, to be referred to subsequently, why the rate of return for the use of capital will generally be larger than the interest rate used in computing depreciation, and when there is such a difference in the rate, the combined annual depreciation and return for the use of capital, as given in Column 7 of the table, will not be strictly uniform from the beginning to the end of the twenty-year period.

It has already been stated that in preparing the table only two of the three factors were taken into account, and the introduction of the third factor—the cost of repairs and operation—will affect the degree of uniformity because as a rule such cost increases as the property grows older. The inclusion of such cost, therefore, will increase the quantities in Columns 6 and 7 to a greater extent in the later than in the earlier years, making the results based on Column 6 somewhat greater in the later than in the earlier years, and those based on Column 7, under most circumstances, more nearly uniform than they are in the table.

It is impracticable to devise any rule which will provide for strictly equal annual payments if the cost of repairs and operation is included, because while as a rule such cost is a small factor in the problem it is variable, and there are exceptional cases in which the cost of repairs and operation differs greatly from the beginning to the end of the life. Practically, however, the exceptional conditions mentioned are unimportant, because where the several items of property have different lives there will be a tendency to equalization of payment on account of the three items of return on capital, depreciation and repairs and operation when the whole property is considered together.

RATES OF INTEREST AND RETURN—It is the judgment of the Committee that a smaller percentage should be used for computing the annual depreciation allowances than would be a proper rate of return for the use of capital invested in public-service properties.

In the past many of those who have discussed the subject, having in mind the creation of depreciation or sinking funds, have adopted a low rate of interest in making their computations of depreciation on the ground that funds safely invested would not give a net return of more than 3 or 4%.

It is the view of the Committee that no such funds should be created, except temporarily, and that the rate of interest to be used in computing depreciation allowances should be substantially the rate at which the corporation can borrow money upon adequate security. In recent years this rate has been about 5 to 5½% for the average well established corporation. To adopt a rate much above 5% for computing depreciation allowances would result in smaller allowances for depreciation in the early years of the life of each item of property, especially long-lived property, than the Committee believes to be advisable.

INVESTMENT OF DEPRECIATION ALLOWANCES—Assuming the Committee's view to be correct, that a depreciation allowance is a return to the corporation of a part of its investment in existing items of property, the money so returned should be treated as a part of the capital and used for any purpose for which the corporation is authorized to use capital, namely: for additions, replacements, betterments, or the extinguishment of outstanding obligations.

It may happen that the amount earned for depreciation allowances will be in excess of immediate needs, and in such cases the accumulations become a part of the working capital until there is an opportunity to invest them in the property.

DEPRECIATION ALLOWANCES IN RATE REGULATION—In any equitable and comprehensive regulation of rates it is necessary that the amount of the depreciation allowances should be determined by logical and proper methods uniformly applied from year to year.

In the case of some properties made up of items which have a short life, like those of telephone companies, the amount which the corporation is entitled to earn for depreciation may be as great as the amount which it is entitled to earn as a return upon its capital.

Where the property is made up of long-lived items, as in the case of water-works property, the amount of the depreciation allowance is still important and should be carefully determined by public-service commissions and engineers if justice is to be done to both the corporation and the ratepayer.

Depreciation allowances should be such that the corporation shall have received, when its property is worn out or become obsolete, neither 50 nor 150% of its value, but as

nearly 100% as the best methods of determining the depreciation allowances will permit.

EXPECTATION OF LIFE—It is generally admitted that the owner of a public-service property is entitled to earn annually a sufficient sum for depreciation to keep his investment unimpaired, and this view is supported by the Knoxville decision of the United States Supreme Court, which states that the company "is entitled to see that from earnings the value of the property invested is kept unimpaired, so that at the end of any given term of years, the original investment remains as it was at the beginning."

Notwithstanding the adoption of this view, many who have objected strongly to using the expectation of life of the different items of property as a basis for determining the depreciation of such property, claiming, especially in the case of property subject to functional depreciation, that any attempt to estimate the probable life is purely guess-work.

There cannot be any doubt that many parts of a public-service property which will not fail through wear and tear or decay are becoming less valuable each year because of approaching inadequacy or obsolescence, and it is the judgment of the Committee that the corporation is entitled to a depreciation allowance corresponding to the lessening worth of all its property. To omit functional depreciation would not, under the present rulings of the Courts, do justice to the corporation, because if the full value of the property has not been returned in the form of depreciation allowances while the property is in use, it will afterward be excluded from the valuation as unused and obsolete property.

In other words, the corporation should receive the whole 100% of the value of an item of property during its lifetime because there is little likelihood that it will receive any subsequent allowance on account of such property, and this can be done only on the basis of the expectation of life of all items of property.

It is not claimed that one can determine accurately the life of any given structure or item of property, but that if experience is used as a guide, inaccuracies in such determination will, to a considerable extent, balance one another so as to give a fairly correct result in regard to the plant as a whole.

It is obvious that precision cannot be attained when one is dealing with the future, but in the judgment of the Committee a greater degree of precision can be attained by a method which deals with the expectation of life of items of property than in any other way.

The statistics of the actual life of public-service property of a permanent character gathered by the Committee, show that such actual life is much shorter than the estimates generally given in publications on the valuation of public utilities, and probably much shorter than the builders of the structures anticipated. Changes which cannot be foreseen are taking place all the time, and the life assigned to the various items of property should be based largely on experience rather than on optimistic views of the future.

How the New Division Engineers of the New York State Highway Department Were Selected

Every engineer who applies for a position for which every one has a fair chance and does not get it always wonders why the other fellow got it when he couldn't; and owing to the peculiar nature of engineering almost every engineer, some time or other, has been a job hunter. So George A. Ricker, first deputy commissioner, New York State Highway Commission, is right when he states in an article on "The Engineer Corps of the Highway Department," in the *New York Highway News* for December, 1913, that the method of selection followed to secure the six new men under the recent reorganization scheme will be of general interest.

He says:

It was a natural assumption that positions of this character should be exempt from civil-service requirements, and that any limitation of the power of the commissioner in the selection of men, so vital to the success of his administration, would be inimical to the interest of the state and unfair to the executive head of the department. After serious and thoughtful consideration of the problem, keeping in mind the needs of the department and our earnest desire to establish and maintain an effective and impartial choice of men, a plan of coöperation between the department and the civil service commission in the preparation and conduct of an examination that would test not only the technical knowledge and practical ability of candidates, but would also draw out and determine their comparative merits as possible executive officers was devised.

Coöperation was readily agreed to by the civil service commission, and a plan of examination worked out that seemed likely to produce the desired results. The examination as outlined called for an oral test to be conducted by the civil service commission and its examiners, sitting with two members of the board of consulting engineers of the highway department and the first deputy commissioner, who is, as required by the highway law, a civil engineer. This test was conducted in the large office of the civil service commission in the capitol at Albany in a most informal manner, in order that the candidates might be as much at ease as possible.

In the oral test technical questions were avoided, as it was rightly assumed that the men appearing were educated and experienced engineers, and that they had anticipated technical questions and were fully prepared to answer them.

Each applicant in turn was asked what kind of a man he thought ought to be selected for a division engineer in the highway department, and what qualifications he thought he himself possessed for the position. Interesting conversations developed in many instances from which it was quite possible to reach a fairly accurate judgment of the personality of the men. In the case of two or three candidates arguments were provoked which let in valuable side lights upon the character of the applicant. One of the men told me afterward that he was greatly chagrined that he had allowed the warmth of his temper to probably offend at least one of the examining board. He did not offend but instead greatly pleased the examiner referred to.

The second test consisted of two theses; the subject of the first being "The Essentials of Highway Construction." The second was upon any large work in which the applicant had been personally engaged. Some very valuable papers were presented and the task of reading and marking them was greatly lightened by their interesting character. The third section of the examination consisted of the sworn statements of experience of the candidates covering the entire period of their engineering work.

In the oral test a rating was agreed upon the whole board and placed in the record before the next applicant was called in. All the members of the board read and re-read the theses presented and weighed carefully their comparative merits. That this form of examination placed upon those conducting it a great amount of work will be quickly recognized, but the very satisfactory character of the examination as it developed, is ample compensation for the efforts expended.

A list was secured of about 60 men out of the original 150 applicants; the ratings of the first 20 men being but 7½ points apart, and of the first ten the differences were generally represented by fractions of 1%.

The civil service law of the state permits the appointing power to select any one of the first three, but in this list it was found entirely satisfactory to select the men in the order as presented and the six men needed were taken from the top of the list down. There were six division engineers to be chosen, three for the divisions added by the last highway law, and three to fill vacancies.

The department of highways is most fortunate in having been able to draw from the Board of Water Supply of New York City one of its best division engineers; from the Barge Canal work of the state of New York three of its competent resident engineers and a capable assistant engineer from the Panama Canal, and from its own ranks a resident engineer of experience who had already won his spurs in highway construction.

In describing how the examinations were conducted, at the recent meeting of the American Society of Civil Engineers, Mr. Ricker stated that practically all the selections had been forecast as soon as the oral tests were completed. Only 60 of the 150 applicants were allowed to take the written tests, and only six new appointments were made; so the reader may judge for himself how much greater an asset was a forceful personality than an erudite textbook knowledge of engineering. All the appointees are graduates of high-grade technical schools and all are members of the American Society of Civil Engineers.

An Unusual Levee Slip

By C. O. Sherrill*

A new levee under construction by the Fourth District Mississippi River Improvement in the main levee line on the east bank of the Mississippi River at Caernarvon, La., 14 miles below New Orleans, presents an unusual foundation condition not heretofore met with in the construction of levees in this locality.

The new levee (Fig. 1) is a loop made necessary by the caving of the river bank up to the toe of the present levee. It is to be 3420 ft. long, with an average net height of 15.1 ft., and of the sectional area shown in Fig. 2.

In order to obviate the difficulty, the levee is now being built with a 70-ft. berm instead of with one 20 ft. wide, and is being placed in the rear of the area previously compressed by the embankment. This work has not advanced sufficiently to allow a definite opinion as to its stability.

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The Second Report of the Committee on Reinforced Concrete of the Institution of Civil Engineers has just been made public under date of July, 1913. The first report was noted in our Engineering Literature section, Oct. 13, 1910, p. 29. The second report is quite similar to the first report of the committee but is radically different from the report of the somewhat similarly intended Joint Committee on Concrete and Reinforced Concrete in the United States. The second report is devoted quite wholly to separate monographs on tests and structures. The tests given are on concrete slabs, perco-

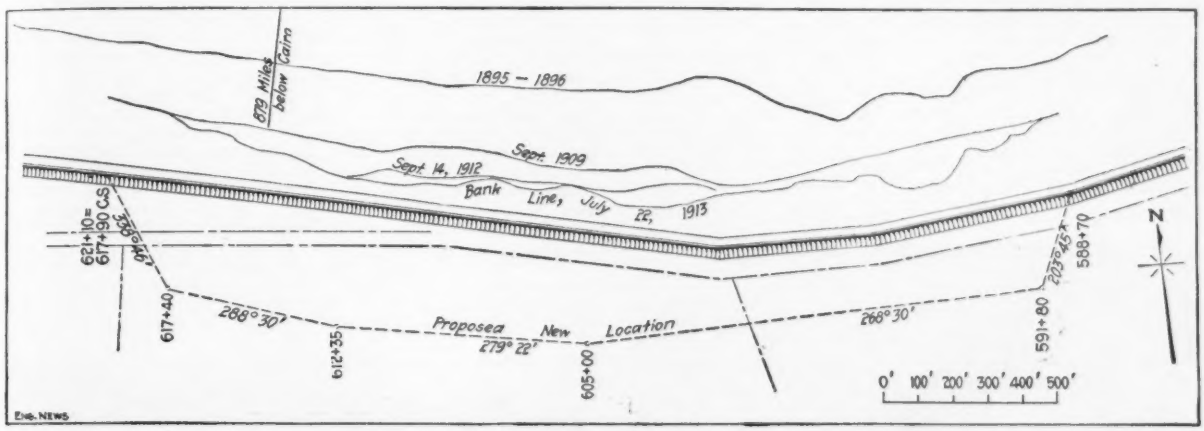

Fig. 1. Plan of New Levee, Caernavon, La., Fourth District, Mississippi River Commission

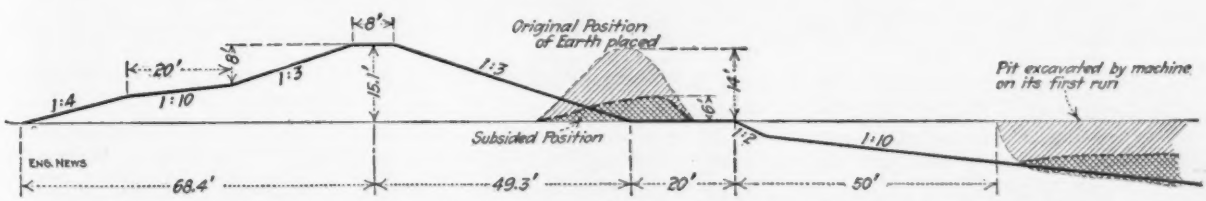

Fig. 2. Cross-Section of New Levee and Sketch Showing Method of Levee Failure

The contractor began the excavation with a 2-cu.yd. orange-peel excavator on Nov. 12, last, taking earth from the back of the allowed pit and placing it on the berm, as shown in dotted lines on the rough sketch (Fig. 2). By Dec. 15, the machine had advanced this work from Sta. 620 to Sta. 611, when a series of subsidences occurred, decreasing the height of fill about 8 ft. between Sta. 618 and 611, leaving the mound of earth and the pits as shown in dash lines on the sketch. There was no disturbance of the natural ground immediately on each side of the embankment, but the bottom of the excavated pit was raised from 3 to 12 ft. above the grade to which it had been excavated.

Settlement of new levees usually results in a corresponding bulging up of the natural earth immediately outside of the fill. In the present case the only disturbance was in the pit, about 50 ft. from the embankment. The earth excavated is a mixture of soft yellow and blue clay with nothing to indicate any unusual tendency to flow or compress.

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lation, beams and columns and reinforced-concrete trusses; the concrete works described are from all parts of the world. There is given finally some data on calculations for reinforced concrete and extracts from the building regulations in use in various parts of the world.

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One Day's Work of a Municipal Engineer—In a discussion on "The Status of the Engineer" before the Engineers' Club, of St. Louis, an engineer connected with the City Engineer's office gave the following notes regarding the various tasks he had had on hand during the day:

I started in by climbing over the roof of the Court House to investigate some leaks. There were several judges asking for a cleaning of their rooms, and while I was there I went over their quarters and looked up the question of cleaning the wall paper and cleaning the ceilings. I went back to the City Hall and spoke to Mr. M. about certain sewers at the infirmary that needed repairs. I went into the Water Department and arranged for some repairs to pipes at the Quarantine Station hospital, and discussed with a boiler company the erection of a smoke-stack at Quarantine. Then I looked after repairs to the tower clock at the City Hall. I called on the Comptroller and Supply Commissioner for a new automobile for the President of the Board, and arranged to "pull it off," too. Then a discussion of the strike of the steel workers on the City Jail came up. I received reports from the contractor on the construction of a bath house, kitchen and two sun porches at the jail, and steam-fitting and boiler installation at the Workhouse, City Garage and City Hospital. I went over specifications and plans for porches for the Infirmary, and also plans for two large public comfort stations to be put under way. Also examined leaks in the roof at Union Market.

The Rusting of Steel Bridges*

By Clifford Older†

Investigation of steel highway bridges by the Illinois Highway Commission indicates that few of these structures are ever painted after final completion and acceptance. Steel structures located in cities or near railways, rust rapidly if not properly protected from the gases produced by the burning of bituminous coal. This is particularly the case where bridges span railway tracks.

The fact that such structures cannot be neglected without danger of serious results is illustrated by a recent investigation of a pony truss bridge carrying an important highway over a railway. The floor planks were supported by wood beams placed at right angles to the roadway and resting on the outstanding legs of the lower chord angles of the trusses. Each lower chord was composed of two 4x5x½-in. angles. The floor planks were placed diagonally. The outstanding legs of the angles for a distance of about 3 ft. over the track were entirely destroyed by corrosion and the vertical legs were materially affected. It is likely that the dangerous weakness of this bridge would not have been discovered had it not been for the fact that the arrangement of the floor supports was such that two of the wood beams were left unsupported and finally fell to the track below. This bridge had been completed but five years.

Salt used for cleaning the sidewalks and roadway of the bridge from ice and snow is at least partly responsible for the corroded condition of the vertical post and the end post shown in Fig. 1. This bridge had been in service about 15 years.

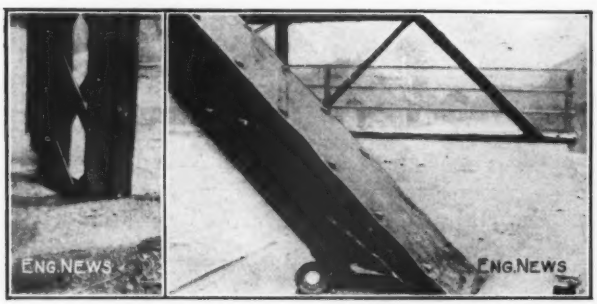


Fig. 1. Corroded Vertical and End Post of a Steel Highway Bridge

In southern Illinois a peculiar condition exists which undoubtedly has a material bearing on the corrosion of steel structures. In that portion of the state popularly known as Egypt, a large proportion of the surface soil when tested, shows a marked acid reaction. This condition exists generally throughout the greater part of the state which lies south and east of the Kaskaskia River and south of the latitude of Mattoon. To a less marked extent, the soil is acid in many places elsewhere in the state where the land has been farmed for 50 years or more.

This acid condition does not exist for a depth of more than a few inches, and steel buried at a greater depth does not seem to exhibit any unusual tendency to corrode. The greatest effect is noticeable at, or slightly above, the ground surface and at other places where dirt may become lodged. Such accumulations of dirt are constantly being washed away by the rains and are again replaced by a fresh supply of the acid soil brought by the wheels of vehicles, the wind or other agencies. Wherever this acid soil accumulates readily (as it does about the shoes, stringers, floor-beams, lower chords, and elsewhere below the floor of the bridge), corrosion is very rapid unless the steel is kept well protected by paint or is incased in concrete.

Examination of many steel structures in the district mentioned has disclosed the fact that steel plates, angles, or the webs of channels or I-beams having a thickness of ¼ in. or less, when exposed on both sides to the conditions mentioned, are completely destroyed by corrosion in from 10 to 12 years. Examination of comparatively new structures seems to indicate that the initial coat of paint affords protection for two or three years. The period of active corrosion is therefore probably not longer than 8 or 10 years.

*Abstract of a paper read at the annual meeting of the Illinois Society of Engineers and Surveyors, at Peoria, Ill., Jan. 28, 30, 1914.

†Bridge Engineer, Illinois Highway Commission, Springfield, Ill.

Fig. 2 shows corroded channels removed from a small bridge near Hillsboro, Ill., which had been in service only ten years. The original thickness of the web was 0.2 in. The position of the most rusted portion was about 12 in. below the floor of the bridge, where a shelf angle formed a lodging place for dirt which sifted through the cracks of the plank floor. The soil is markedly acid in this neighborhood. It may be seen that unprotected steel structures in this district may become dangerously weakened within a very few years. That many more accidents have not occurred is undoubtedly due to the fact that the country in general is poor and, until recently, wood has been largely used for highway bridges.

A peculiar effect of rust action has been observed a number of times during recent years. In examining steel bridges which have been erected for some time, it has frequently been noted that the edges of thin plates, such as the cover plate of a compression member, when riveted to the flanges of channels or I-beams, frequently show a wavy or scalloped appearance. Where this occurs, the plate near the rivets is in contact with the flange of the channel but between the rivets the plate is bulged out in some cases as much as ¼ in., the space between the plate and flange being filled with dirt and rust scale. This condition is distinctly noticeable in case of the end post shown in Fig. 1.

It was not immediately recognized that this buckled condition of thin cover plates was due to the expansive action of rust scale formed between the contact surfaces. That this is true, however, is evidenced by the fact that comparatively new structures do not show any appreciable buckling of thin plates between rivets, and it is inconceivable that faulty shop work should be responsible for the frequent appearance of this phenomenon in bridges built by many different shops and at different periods of time.

The volume of solid iron rust is approximately twice the volume of the metal from which it is formed and as rust scale is always more or less porous, thus still further increasing its bulk, the corrosion of a comparatively thin

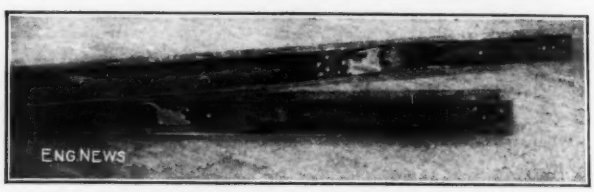


Fig. 2. Corroded Steel Channels from a Highway Bridge

surface layer of each piece produces a sufficient bulk of rust scale to force the pieces apart, thereby causing the bending of the cover plate between rivets. This buckling of one of the component pieces of a compression member, of course, seriously reduces the capacity of that piece to take compressive stresses.

A remarkable instance of the expansive force exerted by rust scale was recently discovered when an examination was made of a bridge which spans Fox River at Ottawa, Ill. This structure has a single span of 234 ft., an 18-ft. clear roadway and a 7-ft. sidewalk outside of one truss. The trusses are really trussed parabolic arches having a center height of 26½ ft. It was completed in 1869. The arch members are made up of Phoenix sections, plates and channels as shown in Figs. 3 and 4. The web plate of the rib on the side carrying the foot-walk, was originally about ⅝ in. thick, while in the opposite rib this plate was probably ¼ in. thick. The thickness of the metal of the Phœnix sections is about ⅜ in. The various structural sections were connected by means of ½-in. rivets spaced 6 in. apart. Owing to the thickness of metal, width of flange and shape of the section, the flanges are very stiff.

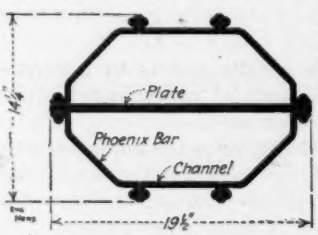


Fig. 4. Cross-Section of Chord

A scale of rust about ⅛ in. thick had formed on each side of the web plate, between the plate and the flanges of the adjacent sections. The expansive force exerted by the formation of this scale had ruptured practically all of the rivets connecting the upper and lower halves of the ribs from one end of the bridge to the other. A length of 10 ft. of one of the arch ribs, shown in Fig. 4, had

FIG. 3. BUILT-UP STEEL CHORD DISTORTED BY THE ACTION OF RUST

but one unbroken rivet. The blade of the knife, A, is inserted where the shank of a rivet ought to be.

In some cases the heads of the rivets were pulled off, but usually the break was in the shank. In a few cases the head was pulled off and the shank broken as well. Examination of the ruptured rivet ends indicated, by varying degrees of corrosion, that some of the rivets had probably been broken several years, while others exhibiting almost no rust, had undoubtedly been ruptured quite recently. Some of the broken rivets show an apparent reduction of area adjacent to the break typical of a tension failure. There were no indications that this reduction was caused by rust. In cutting out the rivets, all indications pointed to a tough and ductile material.

A row of these rivets 5 ft. long was cut out and every rivet was found broken. The tenth rivet, however, was intact and when the head was cut off, a sudden jar was felt accompanied by a splitting noise, as the two halves of the arch rib separated appreciably for a length of 10 ft. or more. Right then the investigator, and others, indulged in an undignified scramble for solid ground. Nothing serious happened, however. It was found that not more than 10% of the rivets connecting the upper and lower halves of the arch ribs were unbroken. It is probable that friction and crooked shanks, due to mis-matched holes had held the parts together. There was strong evidence of a recent working of these joints. The surface steel of this bridge had been protected reasonably well with paint. Scraping disclosed a number of different colors.

Up to the present time it has been impossible to secure any material attention from local highway officials to the importance of keeping steel bridges well painted. It is hoped that, through the County Superintendents of Highways provided under the new road law, this matter as well as others of equal or greater importance may be provided for.

Steel Box Cars; Pennsylvania Railroad

SYNOPSIS—The steel car is coming into service as a companion to the steel hopper and gondola car and the steel passenger car. This article describes the standard design of steel box-cars of the Pennsylvania R.R., which has already over 7000 of these cars.

While all-steel construction is now used very extensively in all types of open freight cars (flats, gondolas, hopper-bottom cars, etc.), and steel underframe construction is used for many types of box-cars, there is a more limited use of steel construction for the body or superstructure of box-cars. These last named steel cars are increasing, however, and mark an important development in freight-car construction.

The Pennsylvania R.R. has adopted a type of steel-frame box-car which is already in extensive use, and one of these is shown in Fig. 1. At present, this road has 5730 of these in service and 1645 under contract, as follows:

Cars	No. in use	Capacity, lb.	Total weight, lb.	Cost
General freight	3370*	100,000	48,100	$1240
General freight, with steel sheathing	1	100,000	49,100	1350
Automobiles	1000	100,000	49,200	1280
Stock and refrigerator	1360†	90,000	60,520	....

*630 more under contract. † 1015 more under contract.

The total weight includes the trucks, which weigh 7750 lb. each, or 15,500 lb. per car. The company's steel-underframe box-cars with wood body construction, of the same carrying capacity, weigh 46,000 lb. with trucks, and cost about $1100 each, so that the additional weight and cost for the box-car with steel-frame superstructure are not great.

In the three classes of all-steel box-cars the framing is identical and the only differences are in the doors and

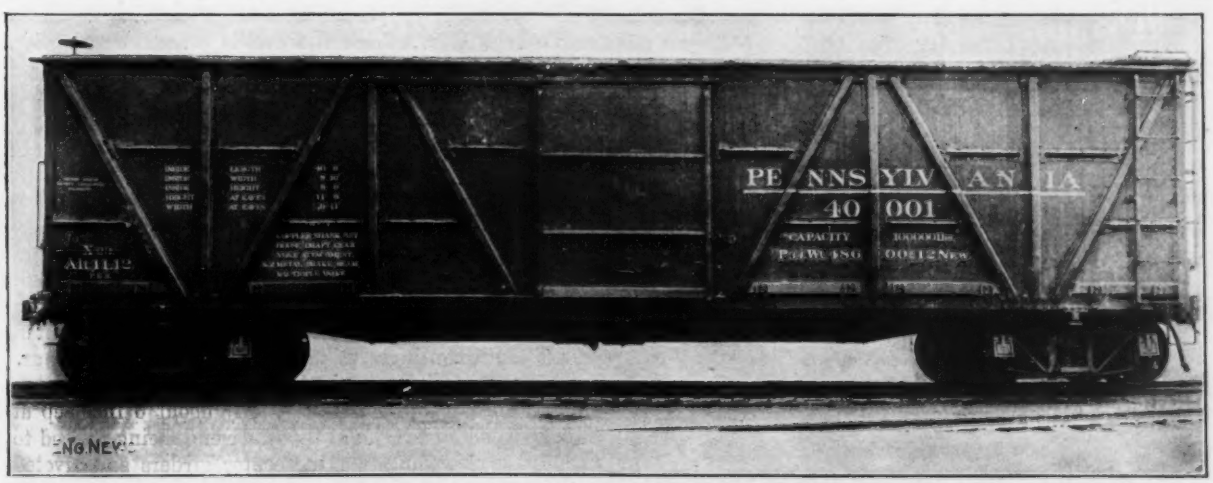


FIG. 1. 100,000-LB. STEEL-FRAME BOX-CAR; PENNSYLVANIA R.R.

sheathing. The cars for general freight have the ordinary side-door openings, which are 6 ft. wide and 7 ft. 3 in. high. The cars for carrying automobiles have larger side-door openings, 12 ft. wide and 8 ft. 5 in. high (with sliding doors in two leaves), while one end is fitted with double-leaf hinged doors to provide an opening the full width and height of the car body. The stock and refrigerator cars have the special sheathing and door construction required for these classes of traffic. The sheathing or siding is of wood, but the company has also one experimental car of the same design with steel siding or sheathing. The general dimensions of the cars are as follows:

	In.
Length over end sills	
Length inside	6
Width inside	6
Width maximum, at eaves	10
Height rail to top of sill	11¼
Height rail to top of running board	3½
Height inside, at center	5
Wheelbase, truck	0
Wheelbase, total	6
	0

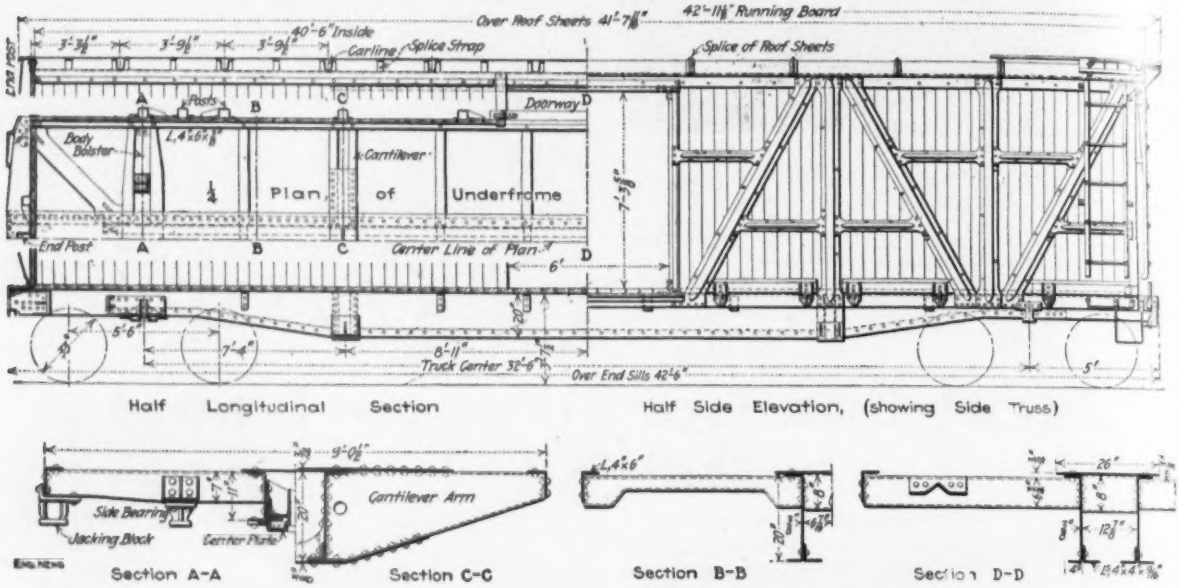


FIG. 2. ELEVATION AND SECTIONS OF STEEL-FRAME BOX-CARS WITH DETAILS OF UNDERFRAME; PENNSYLVANIA R.R.

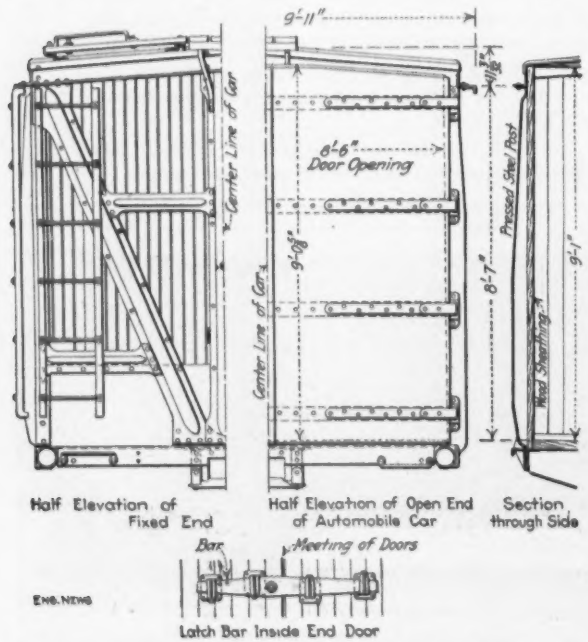


FIG. 3. END ELEVATIONS OF STEEL-FRAME AUTOMOBILE CARS

The designs for all these cars were prepared by the railway company's engineers, under the direction of A. W. Gibb, General Superintendent of Motive Power. Some of the cars were built at the Pennsylvania R.R. shops at Altoona, and others by the American Car & Foundry Co. and the Pressed Steel Car Co.

UNDERFRAME

The general type of framing is of the central-girder or backbone type, as used in the steel passenger cars of the Pennsylvania R.R., described in ENGINEERING NEWS, June 20, 1907, and Sept. 3, 1908. The construction is shown in Fig. 2. The center sill is a heavy box girder, having two pair of cantilevers (back of the bolsters and about 12 ft. from the ends) which carry the side frames or trusses, the load being transmitted in this way directly from the side frames to the center sill.

The center sill is composed of a pair of fish-belly pressed-steel girders of channel form, set 12⅞ in. apart, with the 4-in. flanges outward and having a ⅜-in. cover-plate 26 in. wide extending the full length of the car. The lower flange of each girder is reinforced by an angle 4x4 in. on the inside. The depth of the sill is 20 in. for about 18 ft., and then reduces to 11 in. at the bolster, which depth continues to the end sill. To the webs are riveted the cantilevers, which are pairs of beams of triangular form (and channel section) about 6 in. deep at the outer end and 20 in. at the inner end, being shaped to fit between the flanges of the center girders and riveted against the web of the latter. Top and bottom cover-plates extend across the sill and are riveted to the flanges

of the cantilever arms. Cast-steel struts or braces and pressed-steel diaphragms are fitted between the webs of the center sill in line with the cantilevers.

At six intermediate points along the center sill are transoms or cross-bearers of pressed-steel channels, having their ends flanged and riveted against the web of this sill and the side sill (or bottom chord of side frame). Pressed-steel diaphragms are fitted between the center sill webs at the points where these transoms are attached. The body bolsters are composed of pairs of channels very similar to those of the transoms, with spacing blocks between them, while between the webs of the sill is fitted a cast-steel brace with king-pin socket and rear-draft lug. The center plate is riveted directly to the bottom flanges of the center sill. The body side-bearings are directly under the spacing blocks of the bolsters, while at the ends of the bolsters are heavy shoes or blocks for use in jacking.

The side sills (which are simply the bottom chords of the side-frame trusses) are 4x6-in. angles, with 6-in. channels extending between the ends of the cantilevers.

The end sills are pressed-steel angles, with a flanged plate riveted upon the top, the vertical part of this plate being about 2 ft. high. This extends across the full width of the car and is riveted to the corner posts. The end sill has at each end a malleable-iron push-pocket for pole switching, while at the opening for the coupler shank it is reinforced by a cast-steel brace which forms also the front draft lug. In each corner panel of the underframe is a diagonal strut, of inverted channel section, having its ends spread and flanged outward and riveted to the sills. To resist the thrust of these struts against the center-sill webs, a heavy steel casting is fitted between the webs of the sill at the point of attachment, just forward of the bolster.

Body Frame

The side framing of the body forms a complete truss, as shown in Fig. 2. The verticals and diagonals are pressed-steel members of U- or troughed-section with wide flanges, the ends of the members being flattened and riveted against the 6x4-in. angles forming the bottom chord (or side sill) and the top chord (or side plate). This form of section was adopted as combining lightness with strength. Horizontal struts are riveted between the truss members, as shown, and these serve for the attachment of the side sheathing. The corner posts are pressed-steel Z-bars or 4x4-in. angles, and the door posts are bulb angles.

The side frame is supported upon the center sill by two cantilevers, about 12 ft. from the ends, and two of its main posts are at the ends of these cantilevers, which thus carry the load direct. There are no posts at the ends of the bolsters, so that these do not carry direct load to the center plates. The end framing (Fig. 3) has a center vertical post and two diagonals, and is thus supported directly upon the end of the center-sill girder.

Roof, Sheathing and Floor

The roof has carlines of trough section, with flattened ends resting on the longitudinal angles of the side-frame trusses. The roof construction varies somewhat in the freight and automobile cars, as shown in Fig. 4. In the former, with overhanging eaves, the carlines extend beyond the top-chord angle, and the roof plates are bent down over them, with a small stiffening angle riveted to the edges. At the end the plate is simply flanged over. In the automobile car, the roof sheets are riveted directly against the top-chord angles of the sides, with a stiffening strip between them, while at the ends this strip is omitted.

The roof sheathing is of ⅛-in. steel plates, extending the full width of the car, and bent over to be riveted to the side and end framing. The splices are at or between the carlines, and are butt joints with a flat inside strip and an inverted U-section outside strip for stiffness. No calking of the joint is necessary.

The side and end sheathing, or siding, is of 1¼-in. vertical planks, tongued-and-grooved, fastened by screws through the flanges of the steel framing members. At the top, the sheathing is secured by a 2½-in. bar or strap, while at the bottom it extends below the floor and is secured by wood strips fitted between the truss members and bolted through the side sills. The sheathing leaves a narrow opening for ventilation along the top, but this opening is protected against the entrance of rain or snow.

The floor is of 2⅜-in. plank carried directly by the underframing, so that no extra joists or supports are necessary.

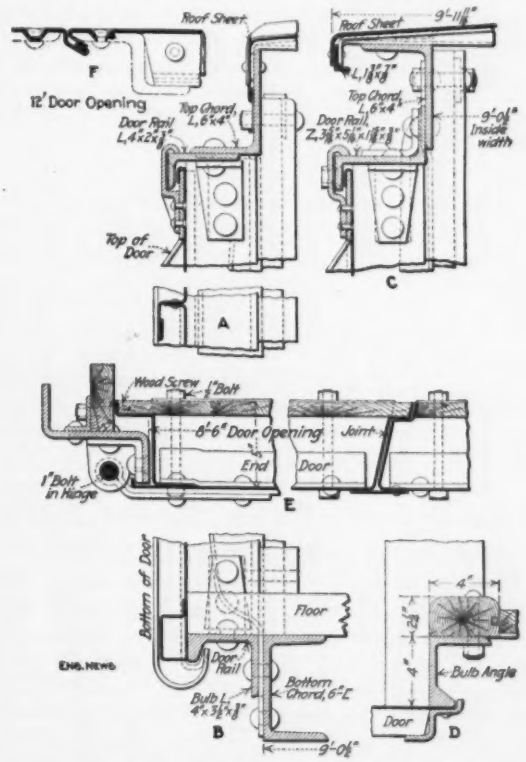


Fig. 4. Details of Steel-Body Frame and Doors of 100,000-Lb. Box-Cars; Pennsylvania R.R.

A-B. Top and bottom of side of automobile car, showing roof and sill construction, door and door rails.

C. Top of side of freight car, showing roof construction and top door rail.

D. Plan of door opening, showing steel door and bulb-angle door post, with wood sheathing.

E. Sectional plan of double-hinged end door of automobile cars.

F. Plan of meeting edges of double sliding door of automobile cars.

Doors

The side doors are of steel plate and pressed-steel shapes, with a Z-bar welded at each end, the lower ends of these bars being hooked to pass under the bottom door rail, which is a bulb angle. No rollers are used, but the door is carried by hooked lugs sliding upon an angle which forms the top door rail, as shown in Fig. 4. The door is set out far enough to clear all posts and braces. In the automobile cars, the side doors are of exceptional size, and are made in two leaves, sliding in opposite directions.

In the automobile cars one end is formed by a door which gives a clear opening 8 ft. 6 in. wide. This door is made in two parts, closing together with a bevel and locking joint, and each part being carried by heavy hinges on the corner post, as shown in Figs. 3 and 4. The fastenings include top and bottom bolts, and a heavy wooden bar which is pivoted to one leaf of the door and fits into lugs or brackets in its horizontal or locking position. One leaf of the door carries the end ladder and a placard board. The doors are of steel, with an inside plank sheathing.

Trucks

All the cars are mounted on trucks of the arch-bar or diamond-frame type, having upper and lower arch bars 1¼x5 in. and bottom tie-bars ⅝x5 in. Upon the arch bars are fitted cast-steel seats for the springs, these castings being connected by a 13-in. rolled channel. The column castings have flanges forming guides for the bolster, which is of box section, 15½ in. deep at the middle and 7⅜ in. at the ends, where it rests on the springs. A cast-steel center plate and center-pin socket are fitted at the middle of the bolster. The axles have journals 5½x10 in.

Valuation of the Street Railways at Los Angeles, Cal.

Under an ordinance regulating the street-railway fares, which was passed by the city council of Los Angeles, Calif. (after having been approved by a referendum vote), the city's Board of Public Utilities has made an investigation of the street-railway system, including the Los Angeles Ry. Co., and the City Railway Co. (the latter's lines being leased to the former). The President of the Board is Augustine W. Wright. The work has been in general charge of George A. Damon, consulting engineer and Dean of Engineering at the Throop College of Technology (who is associated with Bion J. Arnold), while a large part of the valuation has been done by the engineering staff of the Board, under the direction of C. K. Mohler, chief engineer of the railway department. Some particulars of this work will be of interest in view of the increasing tendency to exert public control over public-utility corporations.

This valuation was prepared largely as a basis for rate making, but also as a basis for possible preliminary negotiation for the purchase of the system by the city. The report, however, was filed with the State Railroad Commission by the city in connection with the application of the Los Angeles Ry. and the City Ry. to reorganize and form a new company to be known as the Los Angeles Ry. This new railway was to issue $20,000,000 of stock to be exchanged for a like amount of stock of the Los Angeles Co. and $5,000,000 of stock of the City Ry. Also to issue $50,000,000 in bonds; $20,000,000 to be exchanged for bonds of the Los Angeles Ry. Corporation, and $3,544,000 for those of the City Ry. The Los Angeles Ry. presented a valuation of its property giving a reproduction value about $6,000,000 higher than that shown in the accompanying report.

On Jan. 1, 1913, the street-railway system of Los Angeles consisted of 351 miles of single track, of which 11 miles was three-rail track (3-ft. 6-in. and 4-ft. 8½-in. gage), operated jointly with the Pacific Electric Ry. Of the total, 48¾ miles were outside the city limits, but these are covered by the report as the accounts are not separated. About 94% of the lines are double track, which is considered remarkable for a system of this size.

The system has 809 passenger cars and serves about 1200 people per mile of track. The separate franchises expire within various periods up to 50 years from Jan. 1, 1914, with an average life of 25.75 years from that date. The total valuation of the property, prepared by the Board under the classification of the Interstate Commerce Commission, is $19,762,389. Of this, $15,363,227 is for construction and equipment; the balance is as follows: $768,161 for engineering and superintendence (5% of the last named total), $2,056,001 for right-of-way and land, $1,075,000 for general expenses (law, interest, injuries and damages, taxes and organization expenses), and $500,000 for supplies on hand.

Valuation

This part of the report we abstract as follows, omitting details as to the franchise and finance conditions. The company does not own or operate any power plants, but built and owns the transmission lines to its ten substations. Power is purchased from the Pacific Light & Power Co., delivered at the high-tension busbars of this latter company at a rate of 0.65c. per kw.-hr. This is under a contract running for ten years from April, 1907.

CONSTRUCTION AND EQUIPMENT—To reproduce a system of this size and character would require an investment of approximately $19,800,000. This is an engineer's estimate based upon a careful inventory of the physical part of the system, and does not include any allowance for general contractor's profit, for early losses while building up the business, or for other "development expenses," such as discount on securities, cost of consolidation or investment in superseded property.

The company may claim that the totals are too low. On the other hand, some items probably could be reduced slightly. In considering the investment as affecting the rate of fare, it must be remembered that the return on the investment is paid out of about 25% of the earnings, so that a variation in the amount of the investment of say 10% affects the fare only 2½%, which would be a very small part of a nickel. The valuation of the property as given above is well within a limit of 10% of any other figure which might be arrived at by a more elaborate method of appraisal, and for the present discussion is sufficiently accurate.

It has been estimated that a claim for development expenses amounting to more than $5,000,000 might be made for a property of this kind, but as the original records of the actual cost of developing this system are not available, it has been thought best not to include an estimate, at this time, for this part of the "intangible' value of the property.

A study has been made, however, of the depreciation due to obsolescence, inadequacy and age, and this shows that $4,980,000 should be taken away from the "cost to reproduce," in order to show the depreciated value of the physical plant. This amount offsets the amount which might be added for development expenses. If this offset is allowed, then the figure given as the cost to reproduce the physical plant becomes the actual value of the physical property, $19,800,000.

The above figure includes the property of both the Los Angeles Railway Co. and the City Railway Co. It should be compared with the bonded debt of the system as of Jan. 1, 1913, which shows a total of $22,638,230. The difference can be accounted for by the two items of "working capital"

and "discount on securities," which, if allowed in a fair amount and added to the former figure, would bring the total "present value" up to approximately the latter amount.

REAL ESTATE AND RIGHTS OF WAY—The estimate of the cost to reproduce includes two important items: Real estate for car houses, substations and shops, $990,358; private right of way, $1,065,641.

In accordance with Supreme Court decisions, the corporation has been given the benefit of the appreciation in real estate values, based on the value of contiguous property. There are cases, however, where it was necessary to buy and wreck buildings in order to get the property desired for shop purposes, but the value of these buildings is not included in the real estate figures, as any allowance of this kind should be classified under the head of "development expenses."

Putting a value upon a private right-of-way is a more serious problem. There are some 43 miles of right-of-way, varying in width from 15 to 80 ft. Much of this was acquired at very little, if any, actual cost, being donated to secure an extension of the system to and through the property benefited. The original right-of-way was often a strip 60 to 80 ft. in width, located in advance of street plotting, and maintained for a number of years as a regular railway private way. With the opening up of the streets, the railway company in many cases dedicated the land to the use of the city for street purposes, retaining for itself a perpetual right to operate a double-track street-car system upon a 30-ft. strip, usually in the center of the street.

In estimating the value of this right-of-way in the streets, the number of square feet in each section where a width of 30 ft. was reserved was calculated. If less than 30 ft., the lesser width was figured, but for strips of greater width only 30 ft. was allowed. A price per square foot of contiguous property was determined, and this unit price was multiplied into the area of each respective piece.

It was then decided that, as nearly all of the private rights-of-way would either be dedicated for street purposes or would be reserved as parking spaces down the middle or at the side of future streets, all of the remaining right-of-way could be figured in much the same way. These calculations gave a total of $1,065,641, which would be the value of this 30-ft. strip on the basis of the actual value of contiguous land.

It has been the practice, however, in valuing railway property for rate-making purposes, to give rights-of-way a greater value than the adjoining land, and this practice has been approved by a number of commissions which have recognized various multiplying factors—some as high as three times the real estate value. Since the Supreme Court has decided that public utilities are to be given the benefit of the appreciated value of their land holdings in establishing their present worth, the problem of determining the value of terminal lands and rights in connection with railway rate-making will become a very critical part of the rate question.

EARNINGS AND EXPENSES

ESTIMATED EARNINGS—The income from transportation for the fiscal year to June 30, 1913, will be about $6,800,000, so that the ratio between physical value and earnings is about 3 to 1. The earnings for this year are about 12% greater than those of last year. At a 10% rate of growth the earnings for the next ten years will be approximately $7,480,000 for 1914 and $17,637,446 for 1923.

This estimate is conservative as it is based upon doubling the population in the area served by the local lines during the next ten years and at the same time increasing the earnings per capita from $15.20, the present rate, to but $21 per unit of population served. Records justify a higher estimate of increase in population, as well as in rides per capita, and therefore in the future earnings from local transportation, while the rate of growth in Los Angeles is much larger than in other American cities. The rides per capita are very high—averaging nearly a ride per inhabitant per day—a record exceeded only by San Francisco, where the income per capita is $18.35, as compared with $16.20 in Los Angeles.

The operating expense averages nearly 74% of the transportation income, which is higher than in most cities in this country. It is shown in the following table, which also indicates the cost per car mile and the cost per revenue passenger:

	Percentage of earnings	Cost per car-mile, c.	Cost per passenger, c.
Maint. of way and structures..	12.46	3.03	0.63
Deprec. of way and structures.	3.83	0.93	0.19
Maintenance of equipment...	6.00	1.46	0.30
Depreciation of equipment...	1.92	0.46	0.10
Traffic.....	0.32	0.08	0.02
Conducting transportation....	38.51	9.35	1.94
General and miscellaneous....	3.21	0.78	0.16
Injuries and damages.....	3.11	0.75	0.15
Taxes.....	4.54	1.10	0.23
Total operating expense..	73.90	17.94	3.72

Although this record is higher than ordinarily found with an urban system, it will be hard to reduce the figures. Some economy in maintenance of both way and equipment might be expected, but the reserves for depreciation should be larger than have been allowed. The rate for power may come down, but the cost of labor will probably continue to advance. There will be some advantage to be expected as density of traffic develops, but the requirements for taxes are constantly being increased. There is one sure way to cut operating expenses, and that is by taking cars out of service and cutting down on the operating forces, but this reduces the quality of the service.

CONCLUSIONS

The present interest charge of 5% on the original bonded debt of $20,000,000 and 5% on the $2,600,000 bonds for cost of extensions financed through the City Railway Co. account is a reasonable return upon the present actual physical value of the system, but is not sufficient to compensate for "hazard" and "enterprise" in creating the property.

An annual "dividend" of 2% on $20,000,000, or $400,000 yearly, is a reasonable reward for hazard and enterprise and should be allowed as long as present uncertain conditions continue. An additional "dividend" of a larger amount than $400,000 annually is not justified by present net earnings.

The present five-cent fare, if continued during the coming year under present operating conditions and with a normal increase in earnings, will produce a surplus over and above the amount sufficient for interest charges and reasonable dividends. The control of this surplus should be in the hands of a public regulating body, which should decide upon the disposition of this part of the surplus net earnings for any or all of the following purposes: Better service, extensions, renewals, amortization, or fare reduction.

In anticipating future developments, it is safe to conclude that earnings will increase at a remarkable rate; that the percentage of earnings required for operating expenses should gradually decrease, and that the ratio of investment to earnings should also be reduced—thus making the burden of fixed charges relatively lighter.

CONTRACT ORDINANCE—Taking a broad view of the entire situation, the tendency of developments points to the advisability of the city and the company entering into a settlement of contract ordinance. As a result of this, the entire surface systems should be operated and developed as one single system inside the city limits and the interurban cars should be displaced from the streets into private rights-of-way.

In the report made to the city council by Bion J. Arnold, in October, 1911, he stated that such an agreement should attain the following objects:

1. The best possible street car service at the lowest cost of operation, maintenance and depreciation.
2. The protection of the actual present value of the property plus the actual money invested in future extensions and betterments, and temporarily (until amortized out of earnings) the intangible investment made by the company, comprising obsolescence, and other expenses incurred in developing the property; all of this on the assumption of a reasonable return on the true investment having been paid in the past.
3. The maintenance, periodic renewals and constantly increasing efficiency of the system.
4. Additions and extensions slightly in advance of actual need.
5. One city, one fare, universal transfers, through routes and publicity of records.
6. Public supervision which will include the regulation of the surplus earnings so as to better the service, reduce the fares, or to amortize the obsolescent investment or other costs representing no real physical property, so that the community will eventually pay a rate which will produce a reasonable return upon the real cost value of the physical property producing the service.
7. Public control over plans for additional construction and equipment, regulation of contracts, rates and transfers and control of capitalization, accounts and transfer of power.
8. Right of the city to purchase the property at reasonable intervals and at a fair price, which is not to include any franchise value; and the further right to transfer the property to other agents by paying an agreed bonus.

COMPARISON OF STREET-RAILWAY SYSTEMS

The report is accompanied by comparative statistics of conditions in several American cities, which we have summarized in the accompanying table. Some notes referring to these statistics are given below:

In regard to service, the average number of car miles per mile of track in Los Angeles can be doubled as a whole be-

COMPARISON OF STREET RAILWAY CONDITIONS IN DIFFERENT CITIES

City	Miles of track per sq.mi. of area served	Population mile of track	Car-miles per year 1000 car-miles per mile of track	Car-miles per capita	Passenger per car-mile	Earnings per mile of single track	Earnings per car-mile	Earnings per car	[illegible] (per [illegible] of [illegible]
Los Angeles	4.2	1200	71.7	72	6.20	$16.70	$24.3	$8.40	[illegible]
New York	7.9	5585	139.0	25	8.60	43.40	31.1	....	[illegible]
Brooklyn	6.6	3191	108.0	34	8.10	28.40	26.2	....	[illegible]
Boston	4.7	2545	106.0	42	8.10	32.60	27.4	....	[illegible]
Philadelphia	3.2	2940	122.0	42	6.00	30.35	24.8	....	[illegible]
Cleveland	4.9	2085	94.7	42	7.85	20.93	23.0	7.44	[illegible]
Chicago	3.2	3814	142.0	39	9.10	37.20	26.2	7.02	[illegible]
San Francisco	....	....	....	....	12.03	28.85	37.4	11.89	[illegible]
Milwaukee	....	....	....	....	7.46	28.11	24.1	7.99	[illegible]
St. Louis	....	....	....	....	8.43	....	27.9	7.90	[illegible]

fore the system reaches a congested condition. On the other hand, the number of car miles per unit of population can be reduced 50%, which would seem to indicate that the population in the territory served at present could be increased at least four times before Los Angeles would be a "built up" city of the class used for comparison in the table. From a transportation standpoint the Los Angeles system is working under a handicap of lack of density of traffic.

The gross earnings per car is a measure of the number of cars furnished in proportion to the income. In this respect the record of Los Angeles is relatively high, indicating that the system is short in the relative number of cars which should be owned and operated.

The net income earned after paying all operating charges and retained by the company to pay fixed charges, dividends and for surplus, if expressed in percentage of the total income from all sources, is an exact indication of what proportion of the fare paid is retained by the company as its return and what part of the nickel goes to produce the service rendered.

In his letter to the city council, transmitting the report, the following statements are made by Augustine W. Wright, consulting engineer, President of the Board of Public Utilities:

We wish to emphasize the fact, brought out in the report, that our local street railway is just beginning to "pay." The dividend of $400,000 annually is all "profit," which may be considered that part of a fair return greater than current interest rates on the reproduction cost of the property; but it is justified by the risk taken and the enterprise displayed.

Under the State law the amount of the bonded indebtedness must not exceed the par value of the capital stock for which subscription has actually been made; or, conversely, the stock issue must be at least equal in amount to the bonds carried. There has already been issued $20,000,000 of Los Angeles Ry. and $5,000,000 of City Ry. stock certificates, which are not represented by a dollar's worth of actual physical property, and which are dependent on surplus earnings in order to create a market value. This procedure has always been recognized practice, not only allowable, but actually required by our state laws.

Our first duty is to get control of the surplus. Any surplus earnings over and above a fair return should be available for more cars and better service, extensions, renewals of equipment, reduction of fares, or for depreciation, as directed by the proper public officials. The "extra profit" which is now thought to be "fair" on account of the risk involved in the business, should be reduced or entirely removed by removing the hazard. It must be recognized that if the return upon the capital and upon the enterprise of the company is to be limited, then the actual investment must be made secure.

By taking all the chances ourselves, we can see no reason why the people should not be able to turn the "profit" which they now pay for "hazard" and "enterprise" into an amortization fund, and thus provide for the purchase of the system out of earnings as one alternative, in case the city wishes to undertake municipal ownership.

One of the most pertinent conclusions is that a single contract ordinance should take the place of nearly 250 separate franchises, in order to provide the city with a comprehensive local transportation system adequate to take care of rapid and continuous growth. The facts seem to justify the conclusion that in making such a contract the city could secure not only the right to purchase, but, by guaranteeing the future of the system, could convert excess "dividends" into a purchase fund and thereby secure the controlling equity.

Various Town-Planning Conventions will be held in Birmingham, England, next July. The annual meeting of the International Garden Cities and Town Planning Association will be held on July 24 and the same week there will also meet in Birmingham the National Housing and Town Planning Council and other housing bodies.

The District Engineers for the Interstate Valuation of Railways

As noted in our issue of Dec. 4, 1913, p. 1160, the railway valuation work of the Interstate Commerce Commission is divided into five geographical districts, each in direct charge of a district engineer. The whole work is supervised by the board of five engineers, whose portraits and biographies were published in our issue of May 15, 1913, p. 1019. The members of this board also have, of course, the general supervision of the work in each of their respective districts; on the district engineers, however, comes the burden of detail work, the organization of parties, the assignment of tasks, etc., the breadth and multiplicity of which, and the difficulties of getting started, are probably little appreciated by the average engineer.

The five district engineers are Frank Rhea, Washington, D. C.; DeWitt V. Moore, Chicago, Ill.; John Y. Bayliss, Chattanooga, Tenn.; Carl C. Witt, Kansas City, Mo.; and F. L. Pitman, San Francisco, Calif. Brief biographical sketches and portraits of these engineers are given below.

Frank Rhea

Frank Rhea was born in Armstrong County, Penn., Jan. 11, 1867. He entered the University of Pittsburgh in 1886, but after completing two years of his course left college to enter the service of the Norfolk & Western Ry. In two years he had reached the grade of Supervisor of Track, but he then decided to return to college, where he graduated with the degree of C. E., in 1892.

After leaving college he entered the employ of the Union Switch & Signal Co., Swissvale, Penn., as a special apprentice. A year later he worked for the company as an assistant on the reconstruction of the signal system of the Pennsylvania R.R. at the Broad St. Station, Philadelphia, Penn. As a result of his work here he received an appointment as general foreman of signals of the Philadelphia Terminal division of the Pennsylvania R.R.

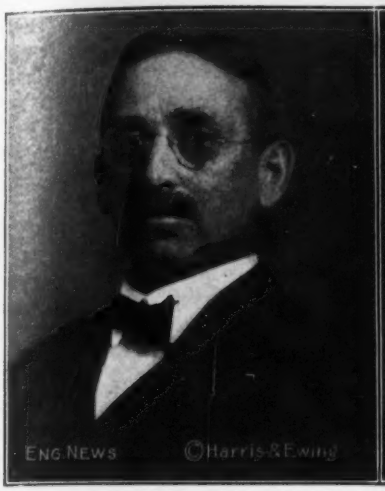
In 1894, Mr. Rhea left the railway service to take charge of construction work for the Clamond Telephone & Manufacturing Co., of Philadelphia, but in two years he was again in the service of the Pennsylvania R.R., first as Chief Signal Inspector of the lines west of Pittsburgh, later as Assistant Engineer and finally as Division Engineer, in which positions he became familiar with the construction and maintenance-of-way side of railway work.

In August, 1908, Mr. Rhea accepted a position in charge of the railway signal department of the General Electric Co. When this company transferred its signal business to the Union Switch & Signal Co., in 1911, Mr. Rhea was assigned to the commercial engineering di-

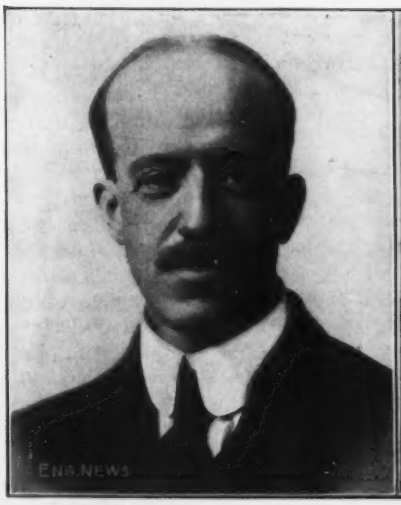
vision, where he specialized in steam-railway work. This position he held when he was appointed to his present office in 1913.

Mr. Rhea is co-author with A. H. Rudd, Signal Engineer of the Pennsylvania R.R., of what is known as the Rudd-Rhea Report, which was the culmination of 15 years' effort to reconcile signal practice on the eastern and western lines of the Pennsylvania R.R. System. This report was submitted in 1905, and the fundamentals of practice recommended have since been generally adopted by the best operated American railways, especially the change from the lower to upper quadrant in semaphore signaling.

Mr. Rhea is a member of the American Railway Engineering Association and the Railway Signal Association.



Frank Rhea — De Witt V. Moore — John H. Bayliss



Carl C. Witt — F. J. Pittman

De Witt V. Moore

De Witt V. Moore was born in Lake County, Ohio, Apr. 6, 1874. After attending grade schools in various places in New York State and Ohio, the Northwestern Normal School, and Hiram College, Ohio, he served a year as an apprentice to an architect and a year as an apprentice in carpentry.

In 1895, Mr. Moore was appinted Assistant Engineer of the Indianapolis Union Ry., Indianapolis, Ind., and two years later he became also Assistant Engineer at Indianapolis of the Pennsylvania R.R. lines west of Pittsburgh. In 1900, he became the partner and Designing Engineer of H. A. Mansfield in the Mansfield Engineering Co., Civil Engineers, Indianapolis, in which capacity he prepared complete reports, maps, plans, etc., for 12 interurban electric railways. In 1902, upon the organization of the Moore-Mansfield Construction Co., Engineers and Contractors, Mr. Moore was elected Vice-President, Secretary and Engineer, with personal charge of the cost keeping and cost analysis. This company engaged in both the design and construction of a large variety of railway and other engineering structures.

Since 1911, Mr. Moore has been associated with the Halstead-Moore Co., building contractors, Indianapolis, as Engineer, Secretary and Treasurer. In addition to this he has had an independent practice as Consulting Engineer and Architect.

Mr. Moore is a Past-President and trustee of the Indiana Engineering Society and is a director of the American Society of Engineering Contractors, of which he is chairman of the committee on cost analysis.

John Y. Bayliss

John Yancey Bayliss was born at Memphis, Tenn., Mar. 18, 1874. At the age of 22 years he graduated with the degree of Bachelor of Engineering at Vanderbilt University. For the first four years following his graduation his experience was on railway surveys, construction of municipal improvements, and telephone-line construction, with one year as a rodman and recorder with the engineering staff of the United States Deep Waterways Commission.

Subsequently, Mr. Bayliss gained his experience on railway work mostly in foreign countries. From 1899 to 1902 he was engaged as an engineer on the construction of the Guayaquil & Quito Ry. in Ecuador. For two years folliwing, he was again in the United States as an engineer on maintenance and construction of the St. Louis & San Francisco R.R. in Missouri and Arkansas, but next went to Central America, where he spent the year 1905 as Assistant Engineer on the construction of the Guatemala Ry., Guatemala.

In 1906, he returned to the United States and for about two years he was Locating and Division Engineer on the construction of the Missouri & North Arkansas R.R. Subsequently he returned to South America, where for the past four years he has been Principal Assistant Engineer on the construction of the Madeira-Mamoré Ry. near the headwaters of the Amazon River.

Mr. Bayliss is a member of the American Society of Civil Engineers and of the Western Society of Engineers.

Carl C. Witt

Carl C. Witt was born in Indianapolis, Ind., in 1870. He graduated from Purdue University in 1892, and for five years was a draftsman and machine designer with the Crane Co., the Webster Manufacturing Co., and the Link-Belt Engineering Co., in Chicago, Ill. His first appraisal work was in 1895 on lumber plants at Pollock, La., and Neelyville, Mo.

In 1897, he became a draftsman and checker for the late George S. Morrison, Past-President, Am. Soc. C. E., Consulting Engineer, Chicago. Later he was employed as a designer, checker and inspector by the Lassig Bridge & Iron Works, also of Chicago. In 1900, Mr. Witt entered the employ of the Chicago & Northwestern Ry., beginning as a designer in the bridge department; subsequently he was Chief Draftsman and Inspector on maintenance and construction work, the most important of which was the construction of the Pierre & Fort Pierre Bridge Ry., including the bridge across the Missouri River at Pierre, S. D. For two years, 1902 and 1903, he was also a partner in a contracting firm engaged in erecting bridges and buildings.

On Dec. 1, 1907, Mr. Witt was appointed Chief Engineer of the Board of Railroad Commissioners of South Dakota, and while serving in this capacity made a physical valuation of all the railways operated in South Dakota, as well as numerous other public utilities. In the summer of 1910 he received leave of absence from his South Dakota work in order to make an appraisal of the physical property of the Chicago, Peoria & St. Louis Ry. in Illinois, for the State Attorney General. Mr. Witt resigned his office as Chief Engineer of the South Dakota Railroad Commission in 1911, and became Chief Engineer of the Public Utilities Commission of Kansas, where he was engaged in making appraisals of [illegible] public utilities at the time of his appointment on the Interstate Commerce Commission railway valuation [illegible].

Mr. Witt is a member of the American Society of Civil Engineers, the Western Society of Engineers and the American Railway Bridge & Building Association.

F. L. Pitman

F. L. Pitman received his early education by the intermittent attendance of the grade schools of Conway, Iowa. In 1884, at the age of 21 years, he graduated from Iowa State College in civil engineering, having completed the regular 4-years' course in 2¾ years. Prior to attending college he had worked as a section hand on the Chicago, Burlington & Quincy R.R.

For a year following his graduation Mr. Pitman taught mathematics in the High School of Clyde, Kan.; he then began his engineering experience as a transitman on location for the Missouri Pacific Ry., where he was soon advanced to the grade of Resident Engineer. In 1887, he was promoted to be Principal Assistant Engineer of the Kanopolis & Kansas Central Ry., a subsidiary of the Missouri Pacific Ry.

Late in the same year he resigned to become Principal Assistant Engineer of the Atlantic & Danville Ry. of Virginia, of which he became Chief Engineer in 1888, having charge of all maintenance work as well as engineering proper. This position he soon resigned, however, because he was not in sympathy with the methods of management, or rather manipulation of the property.

Mr. Pitman was next engaged as Locating Engineer on the Wilmington, Onslow & East Carolina R.R., now a part of the Atlantic Coast Line Ry., in North Carolina. Here he was successively promoted to be Construction Engineer and finally Chief Engineer, in which position he remained until the completion of the road in 1891, when he was appointed Chief Engineer of the Norfolk, Wilmington & Charleston R.R., a projected short line from Norfolk, Va., to Charleston, S. C., which was never built, although very complete surveys and plans were made. The undertaking was unable to withstand the financial stress of 1893, although efforts to carry out the elaborate plans which had been developed were continued well into 1894.

Returning to the Middle West in 1895, Mr. Pitman entered the employ of the Kansas City Southern Ry. as Locating Engineer and later as Resident Engineer on construction. In 1896, and for a period of six years, he was engaged in business in Oklahoma, during which time he was also employed as Chief Engineer of projected railway lines in this territory.

In the latter part of the year 1902, Mr. Pitman moved to Washington State where he became interested in the development of the Sunnyside Ry. Co., of which he became Chief Engineer. In 1905, he was placed in charge of location surveys for the North Coast R.R., a subsidiary of the Harriman lines, which was afterward merged with the Oregon R.R. & Navigation Co., as the Third district. This district embraced about 700 miles of lines, which were thoroughly developed and definitely located; more than 200 miles were built under Mr. Pitman's direction.

Mr. Pitman is a member of the American Society of Civil Engineers.

Notes From Engineering Schools

BROWN UNIVERSITY—A course in industrial organization and scientific management will be given for the first time during the second semester of the present year. The course is an outgrowth of a summer course in scientific management conducted by Prof. J. A. Brooks and Mr. F. B. Gilbreth.

UNIVERSITY OF ILLINOIS—Miners and Mechanics Institutes are to be established under the direction of the Department of Mining Engineering with R. Y. Williams, Director. Establishment of these Institutes was authorized by the legislature in 1911, but no appropriation was made until 1913, when $15,000 per annum was granted. These Institutes are intended to assist men who are preparing themselves to pass tests for state mine positions.

UNIVERSITY OF KANSAS—A correspondence course in water filtration and pumping will be given as state extension work. Prof. C. A. Haskins, as state sanitary engineer, found the men in charge of the water-works of smaller cities inexperienced and without technical knowledge of the works.

UNIVERSITY OF WISCONSIN—The engineering courses of study have recently been modified. (1) A reduction has been made in the amount of work required, especially in the first two years. (2) An increase has been made in the number of elective hours in the later years of some courses. (3) Students, who have had three or four years of foreign language study, may omit that subject from their courses. In that case, English prose style is substituted in the Freshman year; students studying a foreign language in that year take this English work in their third year while the others take advanced work in their own or allied fields for the third and fourth years. Those having to study foreign language in their course thus lose one year of advanced work in some technical subject. The "shortened hours" of the first two years show 18 to 20 "credit" hours equivalent to some 24 hours actual time on account of double laboratory periods, etc., which are credited only as single hours.

SYRACUSE UNIVERSITY—Plans have very recently been completed by the State Architect for the new State Forestry Building. The structure will be of Indiana sandstone, 282x64 ft. It is planned to make it the largest and most thoroughly equipped forestry building in the United States. Throughout, the building will be arranged with the idea of making it a practical workshop for the training of foresters. In the basement of the building are to be three large laboratories, one a complete paper-making plant, the second a laboratory for testing timber and the third a complete wood-working shop. It is expected that the paper plant and the timber laboratory will be second in equipment only to the government laboratories at Madison, Wis. On the upper floors there will be very complete laboratories for teaching of dendrology, silviculture, forest pathology and entomology, and forest soils. The soils laboratory will contain a special drying room and there will be two small laboratories attached, in which private research will be carried on. Upon the third floor of the building there will be an auditorium with a seating capacity of over 400.

PURDUE UNIVERSITY—At the recent road conference for county surveyors and commissioners, road superintendents, city engineers, etc., the following resolutions were adopted:

Whereas, the laws of the state of Indiana provide a County Superintendent of Roads of each county whose duty it is to maintain the county highways and to establish standards for culverts and small bridges, and

Whereas, a necessity exists for an interchange of experiences and ideas between these county superintendents leading to improved discharge of their duties, and

Whereas, no agency exists for such interchange of experiences and ideas,

Therefore, be it resolved by this conference, that provision should be made by the laws of Indiana for a yearly School of Good Roads, which shall be the official school of instruction and meeting of the County Road Superintendents; this school to extend for at least ten days, to include instruction by lectures and laboratory work, discussions on the construction and maintenance of highways, and on the manufacture and testing of road-making materials; the school to be open to every one, and no fees to be charged; the per diem and expenses of the County Road Superintendents, while in attendance upon this school, to be paid by the county.

And further be it resolved, that this Road School be held at the School of Civil Engineering of Purdue University, and the course of instruction be conducted under the supervision of the school by the members of the faculty and other experts.

HARVARD UNIVERSITY—Four new courses are to be offered by the Department of Sanitary Engineering. The first one is in demography under George C. Whipple for students in the school of health officers, and for graduate students in the school of business administration and in the engineering school. The study, preparation and interpretation of vital social and sanitary statistics will be dealt with, special emphasis being placed on application to public health work. It will take up principles of statistics, population, legislation, births, deaths, marriages, etc.

The second course is in rural sanitation under Dr. J. W. M. Bunker. This is for students in the school of health officers and for properly qualified graduate students in the University. It deals with the principles and practice of sanitation and hygiene as applied to the farm, summer resorts, camps, etc. Among the topics will be small water-supplies and sewage-disposal installations, the construction, ventilation and heating of small buildings, the sanitation of farms and dairies, mosquito and fly nuisances, etc.

The third course is in elementary bacteriology under Dr. Bunker. This is intended for students who have never studied the subject, but who wish to gain a general understanding of its relation to natural processes, chemistry, sanitary science, and health. It will require about nine hours per week, three of lectures and six of laboratory.

The fourth course is in sanitary municipal engineering under Prof. Whipple, and is open to graduates and undergraduates specializing in government and business administration. It deals with the principles of municipal sanitation and sanitary engineering, with special reference to city administration. Among the topics are public water-supplies, water-purification, pollution of streams, sewage, garbage and waste disposal, street cleaning, housing, plumbing, ventilation, etc., with attention to the operating cost of works rather than to construction.

OHIO STATE UNIVERSITY—The members of the Student Branch of the American Institute of Electrical Engineers at this institution will give an electrical show this year similar to the one which they gave several years ago. On Apr. 16-18, there will be exhibits from several hundred manufacturers of different kinds of electrical apparatus and machinery.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY—An investigation of the delivery service of the New York department store of R. H. Macy & Co. will be conducted by the Institute's Electrical Research Division. Purchases at this store are now distributed without charge between Stamford, Conn., and Seabright, N. J., over an area equal to about one-third of Massachusetts. To provide quick delivery, there is a system of operating depots in various delivery zones. Packages are sent from the main store to these depots in large vans and from these points radial deliveries reach the customers. This requires approximately 400 vehicles and the expense approaches $1,000,000 per year. A special staff of three research assistants will study the store methods, character of delivery, zones and distances, speeds, loads, running and idle times of the vehicles, etc. Especial attention will be directed to the expenses of delay of delivery wagons in congested traffic, waiting for ferries, individual deliveries in apartment houses, etc.

Education in aëronautics and aërodynamics abroad was recently reported on before the Alumni Council of the Massachusetts Institute of Technology, by Lieut. J. C. Hunsaker, U. S. N., who has been detailed for work in developing such a department at this school and who spent last summer abroad studying what was being done in this field educationally and experimentally. He reported that:

> In England research is carried on most actively at the National Physical Laboratory on models and at the Royal Air-Craft Factory on full-sized machines. Practically unlimited funds are available. At Northampton Institute in London, evening courses are given in aëronautical engineering, and the school has a wind tunnel.
>
> In France, the foremost civil engineer, Gustav Eiffel, has retired from his profession and is devoting the remainder of his life to aëronautical research. His private laboratory has the most powerful wind tunnel in the world, with a 6-ft. side and a wind current of eighty miles an hour. The army maintains an experimental laboratory at Chalois-Meudon and the University of Paris has an extensive laboratory at St. Cyr, where there is a tunnel, and whirling table for models and a dynamometer car for full-sized aëroplanes. The Ecole Superieure Aëronautique has been founded to educate engineers in the work, and here courses are given by the most eminent specialists in France. Forty men were graduated last year.
>
> In Germany the University of Göttingen has an aëronautical laboratory to which only candidates for the doctor's degree are admitted as research assistants. The Technical high school at Berlin, and also at Aachen, have courses in aëronautics and have laboratories. Further, the German Society of Engineers maintains a very complete laboratory at Aldershof, near Berlin.

KENTUCKY STATE UNIVERSITY—A radical change in the policy of engineering thesis work has been instituted at this college this year. The entire senior class will handle a combined thesis, consisting of the design of a 15,000-kw. power plant to furnish power to all of central and eastern Kentucky. A complete set of drawings (about 125) will be made and all necessary specifications will be drawn up. An attempt will be made to carry on the work just as it would be conducted in a large consulting engineering office, so that when the design is completed the plant could be actually built from the drawings and specifications. In carrying out the work on this scheme regular schedule of class hours will be suspended and an eight-hour working day be established. One of the instructors with experience in this sort of work will devote all of his time to the thesis study, acting as chief draftsman. All preliminary calculations and designs will be completed during this term, in connection with class work in theoretical power-plant design. The assumed location will probably be in the coal fields of eastern Kentucky. Before the thesis work actually begins the senior class will be taken to the locality for preliminary examinations and surveys. If the time allowed does not permit the senior class to do all the work, some tracing will be given to lower classmen. Sargent & Lundy, of Chicago, have loaned the college a complete set of drawings and specifications for a modern plant and these will be used as references on details of practice.

WEST VIRGINIA UNIVERSITY—The School of Good Roads has been organized to comply with the act of the 1913 legislature which requires all county road engineers to attend the office of the State Road Bureau at least ten days for instruction. It is expected that there will be two types of men attending this school; those who have had practical experience and those who have had special training. To promote the exchange of information between these two classes general discussions will be given after each lecture. Besides the regular teaching staff of the University, men of reputation in special lines will assist in the work of this short course which will be given Feb. 10-20, 1914. There are no requirements and no fees. The course is open to everyone who wishes to enter. Coincident with the school will be a meeting of the West Virginia Good Roads Association.

The school will take up first the organization of work, with field demonstration of locations, alignments, grades, cross-sections, etc. This is followed by earth-road construction; the use of road machinery of various types; foundations and drainage; bridges; road materials of the state; brick, macadam, concrete, sand-clay roads; bituminous-bound surfaces; road oils and dust preventatives; tests of materials; methods of repair; records, contracts, accounts, settlements, etc. Interspersed between these special subjects are a number of general addresses on economics, etc.

The Electrification of Chicago Railway Terminals and the question of smoke abatement are touched upon in a brief report to the Chicago Association of Commerce by its committee on Smoke Abatement and Electrification of Railway Terminals, of which Jesse Holdom is chairman and Dr. W. F. M. Goss is chief engineer. The report states that researches concerning sources of atmospheric pollution are completed and the facts gathered are being prepared for presentation.

The committee has investigated locomotives which might be substituted for the existing steam locomotives in the terminal district in order to reduce the noise and smoke. It has considered the Diesel-engine-locomotive and other internal-combustion locomotives, and also the possibilities of storage-battery engines, but no locomotive of such type has been produced in any country which is capable of performing the present-day switching and other services in the railway terminal work of Chicago.

The committee is at work upon important problems affecting the technical practicability and the cost of complete electrification. The problem of the contact system for delivering electrical energy to locomotives and cars is being carefully worked out. The changes in existing structures, such as overhead bridges, station platforms, signal masts and bridges, track circuits, etc., are being listed and the cost of such changes estimated, so that there will be a full and accurate reckoning of what must be done and the cost which will be entailed in order to secure the complete electrification of the existing railway terminals.

Studies are being made concerning the financial practicability of carrying out this extensive program of electrification. Most of the material necessary to solve the question of the necessity and the mechanical feasibility of such electrification is in hand, but the information as to the financial practicability is not sufficient at this time to enable the committee to determine this phase of the problem.

Editorials

Statistics of Men Out of Work

There are more than 330,000 unemployed men in New York City at the present time, according to statistics made public on Feb. 3, by the Bureau of Employment of the Association for Improving the Condition of the Poor, a New York charity of long standing. These figures are the result of a two months' careful canvas made by agents of the association who obtained information from many trade unions, from the managers of large construction companies and industrial corporations, and from employment agencies and charitable institutions. The figure given above, moreover, is the total of separate estimates of the number of unemployed men in fifty or more different trades. It is of interest to note that the total number of those out of work includes 140,000 unskilled laborers, 70,000 workers in the building trade, 18,000 longshoremen, and 18,000 cloak and suit makers.

It is difficult to comprehend the vast total of destitution, suffering and misery which these figures represent. Three hundred and thirty thousand wage-earning men idle represents a city with a total population of probably at least a million and a quarter inhabitants.

The Association making public these figures emphasizes in connection with them, that only a very small proportion of these unemployed men are of the vagrant or habitually idle class, and probably not more than one-sixth belong to the class of casual workers, whose employment depends largely upon the season.

From Chicago and other industrial cities come similar reports that great numbers of men are out of work.

Besides the personal suffering involved, the economic waste involved in the idleness of this vast number of willing workers, who are for the time being against their own will compelled to use up their accumulated savings or live on charity instead of earning their daily living as usual, makes it a problem that challenges the attention of every thinking man.

Misleading Advertisements by Correspondence Schools

A correspondent sends us a page from a current magazine containing two advertisements of correspondence-school instruction, and suggests that the publication of such advertisements ought to be made a misdemeanor. We quote the following extracts from these advertisements to give the reader an idea of what glittering prospects they hold out to students.

The first advertisement is headed in large letters: "*Become a Traffic Expert. Learn at Home.* New jobs open. Big pay. Positions are open everywhere with salaries of $35 to $200 weekly. All you need to get into this powerful, big-paying occupation is our training. No matter where you live or what you work at now, no matter what your age or education, if you can read and write, our interstate commerce course will train you expertly to handle proficiently a big Traffic Manager's job, to merit and retain influence, respect, power and $35 to $200 weekly. Remember that big employers are seeking our graduates because of their efficiency."

The other advertisement is headed "*Be a Signal Engineer.* Earn $2500 a year. Hundreds and hundreds of men making much more than that. Even while you are learning you can hold one of the positions paying you $75 to $195 per month. You can get just the kind of instruction to hold one of the big jobs in your own home during your spare time. Thousands of men are needed. There are not enough men to fill the positions now open."

It is needless for us to explain to the readers of ENGINEERING NEWS how utterly false and misleading are such statements. Nor need we emphasize the pitiful disappointment that must eventually be experienced by those who read and believe such advertisements and spend their hard-earned money and burn the midnight oil in the hope that by a few weeks or months of home study, with no practical experience whatever, they can fit themselves to accept one of the lucrative positions which they suppose is awaiting them.

Of course, it may be said with truth that much of the advertising of the numerous correspondence schools in many fields deserves more or less criticism of a similar sort. Students are induced to spend their money and time on the courses by advertisements which hold before them attractive visions of future prosperity and success. There may, however, be some excuse for such advertising when it arouses latent ambition in a man and induces him to use his spare time to improve his mental equipment, and when the instruction given does aid him to fill better whatever field of work he may undertake. But there seems no excuse whatever for holding out to a student the prospect that by a brief period of home study at some special occupation or profession, he will at once be able to command positions which are actually filled only by men of mature years and experience.

It seems to us that such advertisements as those above noted might properly be taken up by such organizations as the Railway Clubs or the Society of Signal Engineers. It is altogether likely that on proper representations from any of these organizations, the Post Office Department would take steps to see that advertisements of such a misleading nature were debarred from the mails.

A Profitable Study of a Derailment Accident

Among the notable railway accidents of 1913 was a derailment which occurred on the Mobile & Ohio R.R., near Buckatunna, Miss., on Oct. 19, which caused the death of 17 passengers and the injury of 139 passengers and six employees.

The Interstate Commerce Commission has just made public its report of the investigation of this accident, which appears to have been due primarily to high speed on a curve. The large number of casualties in the acci-

dent were due to the fact that the derailment occurred just before the train reached a wooden trestle some 225 ft. long and about 24 ft. high. The wheels of the truck which was derailed before the bridge was reached, bunched the ties on the trestle floor and the collapse of the trestle resulted, the whole train back of the tender falling into the ravine which the trestle crossed.

It is not stated whether there was any blocking between the ties to prevent their being bunched by derailed wheels and it is probable that this very important feature of a trestle floor was omitted. The outside guard timbers were fastened by lagscrews to every second tie.

The derailed wheels which caused this serious disaster were the wheels of the forward truck of the locomotive tender. At the time of the derailment, the train was traveling at a speed of probably between 55 and 60 miles per hour, over a 3° curve on which the superelevation of the outside rail was only 3½ in. The Chief Inspector of Safety Appliances, H. W. Belnap, says in his report on the accident:

> On account of the high speed, with the insufficient superelevation on this curve, it is probable that the wheels on the left side of the tender were lifted from the rail due to the high center of gravity of the tender and the surging of the water to one side of the cistern, and that when the tender rocked back, the flanges of the wheels on the inner side came down on the ball of the rail, running along in that position a short distance before dropping off on the outside.

Mr. Belnap gives also a list of sixteen serious derailments which have been investigated by the Commission since July 1, 1911, in which high train speed was either the primary cause or a contributing cause of the accident. In eleven of these derailments the tender wheels were the first to leave the track. Usually the forward truck of the tender is the one to be derailed. Commenting on this Mr. Belknap says:

> Derailments of this kind form one of the most perplexing problems with which operating and mechanical officers have to contend. They often occur under such circumstances that the real cause is never definitely determined. On account of its comparatively short wheel base and high center of gravity, as well as the movement of water in the tank surging back and forth and from side to side, the tender is subjected to forces with which it is particularly difficult to deal and which are aggravated by any irregularities which may exist in the track. Derailments of this kind occur more or less frequently on every large railroad in this country. Such derailments should be given the closest possible study with a view to definitely ascertaining their causes and eliminating them as far as practicable.

This is by no means the first time that the liability of tenders to derailment has been called to public attention; but such a serious accident as that on the Mobile & Ohio ought to emphasize the urgent necessity of energetic action to remedy the weak points in design in order that such derailments may be prevented. If the center of gravity of modern large-capacity tenders is too high for safety, then measures should be taken to lower it. Because tender tanks have always been made with flat bottoms to rest on the tender floor, it does not follow that they necessarily have to be made in that way. It should be quite possible to design a tender tank with a deep bottom extending down between the forward and rear trucks like a hopper-bottom coal car. Swash plates could be riveted inside the tank to check the swaying and surging of the water at high speed.

The action of the trucks might well be studied, especially with a view to the binding of the trucks in rounding a curve and the behavior of the trucks of such a short wheel-base vehicle in running over rough tracks.

It has often been pointed out that European railways with their rigid wheel-base cars seem to get along with fewer derailments than occur on American railways where all car bodies are mounted on trucks. It is hoped that such investigations as this by the Interstate Commerce Commission may result in a greater appreciation by railway officers of the need for better mechanical design and attention to engineering principles in rolling-stock construction, and in more thorough study of the relation between rolling stock and permanent ways.

Concerning Concrete Roads

There has been no more active subject of discussion in the field of road engineering during the past year than the merits and demerits of the concrete road. On the one hand, its active partisans are heard claiming that the concrete road furnishes for the first time a permanent road surface at a moderate cost, and is destined to supersede all competing forms of highway surfacing as soon as its merits are fully understood. On the opposing side it is declared that the whole furore over concrete roads is due to the cement manufacturers, who are merely after a market for their product and that concrete roads, instead of being permanent, rapidly succumb to the action of traffic and the stresses caused by changing temperatures.

The National Conference on Concrete Road Construction to be held in Chicago this week calls the attention of engineers anew to the concrete road and to the controversies over it and makes some discussion of them here appropriate.

It is true that there is among engineers a large amount of skepticism concerning the concrete road, much of it, it is fair to say, based on more or less experience. The question is asked, for example whether the conference to be held at Chicago next week is not a mere advertisement financed by the cement manufacturers to boom the concrete road.

In reply to this, it may be frankly said that the prominence of the concrete road and the success it has attained in the past two or three years is very largely due to the systematic business methods adopted by some of the leading cement manufacturers to further the construction of such roads. That the conference at Chicago next week is also due to their initiative and liberality is also admitted; but that the meeting is to be merely an advertisement for concrete roads does not at all follow.

The cement makers and their engineers who are promoting this development understand perfectly that they can obtain no permanent market for cement in this field unless the concrete road can be made a permanent success—a road that will permanently satisfy road users and taxpayers. They know also that to build such concrete roads is not merely a method of mixing and placing so much cement and sand and stone. The engineers and contractors who execute the work must have the necessary knowledge and skill. Further than this, those who have given most study to the concrete road are aware that we have not yet reached perfection by any means in the work. There are many details of the work on which division of opinion exists, even among those of most experience. It will probably be possible in the future to build better concrete roads than have yet been built and particularly to build them at lower cost. The object of those

who have made possible the conference next week at Chicago is not merely to advertise widely the merits of the concrete roads, but to promote the further development of the art by bringing together those of most experience for an interchange of ideas.

It cannot be too much emphasized in the discussion of this as of every other problem in connection with road construction that the economic side of the question must always be the controlling one. The question is not how good a concrete road can you build but how good a concrete road can you build at how low a cost per mile? No engineer, at least, expects that any surface of cement concrete can resist the abrasion of traffic like vitrified brick or stone block or asphalt. What the engineer wants is a road surface sufficiently durable which can be obtained at a much lower cost than that of the older permanent pavements.

And this leads directly to one of the chief reasons for the sudden rise of the concrete road into prominence, namely, the increasing use of rubber tires. There are already many highways where 90% or more of the traffic consists of rubber-tired motor cars; and while the rubber tire is exceedingly destructive to a waterbound macadam road, it has little or no abrasive effect, so far as our present knowledge extends, on a hard, smooth surface of concrete. Wherever automobile traffic constitutes the great bulk of the travel, therefore, and particularly where there is little use of the road by heavy steel-tired vehicles, the concrete road will show greatest durability and give greatest satisfaction to the users of the road.

Again the concrete *road* is more likely to have permanent success than the concrete *street*, not only because a street has usually a greater variety of traffic, including horse-drawn trucks, but because the street surface must be more or less frequently disturbed for excavations. While a concrete pavement can be cut through and repaired afterward, the junction of the new concrete with the old is bound to be a weak spot; and it is difficult indeed to secure first-rate work in such patching. On a country road, however, it will almost never be necessary to bury any pipes beneath the paving. If pipes are carried along the roadway, they can go to one side and be accessible without disturbing the paving.

Every road engineer of experience knows that the first fundamental requirement of good road construction is thorough drainage and a stable foundation; but there is no type of road surface for which it is more necessary than the concrete road. A waterbound or bituminous macadam road can follow any settlement of the foundation and resulting depressions on the surface can be filled; but a concrete road is an unyielding monolithic slab. If the soil beneath it settles unevenly, the concrete will bridge the soft spot until the stress becomes too great and then it will crack.

But in a very large part of the good road construction now carried on, there is considerable grading to be done before the final wearing surface is applied. It is all very well to specify that the subgrade shall be rolled till it is thoroughly compressed, hard and firm, before the paving is laid; but if this specification were literally enforced, the resultant cost would be a serious matter. Most engineers will agree, we believe, that a concrete roadway ought not to be laid on a new fill until it has had at least a season to settle; and a road which has been thoroughly compacted by a year or more of traffic is certainly a better foundation for a concrete slab than any newly graded road.

But a certain amount of grading and rolling should be done even where concrete is laid on an old road surface. The use of the concrete to level up the surface is likely to lead to trouble. The finished concrete slab which constitutes the road surface should be of even thickness throughout; or better yet, instead of rolling the subgrade to the same crown as the finished surface, it is rolled flat, and the concrete is made thicker at the center than at the sides to give the very slight crown which is required.

It is one merit of a concrete road that the crown may be kept flat. Sufficient slope to make the water run off the surface, notwithstanding slight inequalities in the finishing, is all that is called for; and it may be noted also that water standing on the surface is not at all the serious enemy to a concrete road that it is to most other pavements such as asphalt or macadam with any form of binder.

Doubtless the question of all others that has been most fought over in connection with concrete roads is the provision for expansion and contraction. The ideal climate for concrete roadways is a climate with a small range of temperature, such as that on the north Pacific coast or at Panama. On the other hand, the largest use of concrete roads and the greatest successes have been in the middle West. The famous Wayne County concrete roads near Detroit are certainly exposed to as great a range of temperature as would be met almost anywhere.

One reason why the temperature stresses, the expansion joints, and the cracks in concrete roads resulting from contraction and other causes have been so much discussed is that the method commonly adopted for the repair of cracks—filling the crack with tar or asphaltum mixed with sand—makes every such repaired place evident. Criticisms have been widely published of concrete roads in which these cracks are commented on and described as if they signified the practical ruin of the road.

It seems to us that such criticisms are wide of the mark. Even with the best of materials and skill used in concrete-road work, some cracks are liable to occur. Certain engineers even advocate the omission of contraction joints in the original construction entirely, claiming that it is better to let contraction cracks form where they will and take care of them as they occur. It may be admitted that the black line of the tar and sand along the crack does not improve the appearance of the concrete road; but in a road surface, if anywhere, surely, "handsome is as handsome does." Experience seems to show that a crack in a concrete road surface properly treated with bitumen gives little more trouble than a joint in a block pavement similarly filled.

The future success of concrete-road construction depends quite as much on the extent to which engineers and contractors engaged in the work can keep down the cost as upon their success in making a pavement which will withstand the stresses of traffic and weather. There is some danger that in making too elaborate provision for temperature stresses, etc., the cost may be raised to a point at which the concrete road will no longer look attractive. When the cost approaches $2 per sq.yd., many will prefer to pay a little more for a brick road or a bituminous macadam road of established excellence. If, however, the price can be kept down in the neighborhood

of a dollar a square yard it is difficult to set a limit to the probable volume of the business.

And there is no apparent reason why, with conditions generally favorable and with the application of labor-saving machinery in mixing and laying, the cost might not be kept down in the neighborhood of a dollar per square yard. With one-course pavement 6 in. thick this means an average price of $6 per cubic yard for the concrete in place. The materials themselves, even with the rich mix now generally agreed to be essential for concrete-road work, will seldom cost much over half of this. With machine mixing and mechanical conveying, the labor cost should be kept down so as to leave a fair margin of profit.

We are not including in this, of course, the expense of grading and preparing the subgrade, which varies widely with different conditions.

If the cost of concrete-road construction can be kept down to the neighborhood of a dollar a square yard, then it promises to become a great boon to a large section of the Mississippi Valley, where local road-building material, such as the gravel so abundant in the Eastern states, is wholly lacking. Stone for macadamized roads has to be brought by rail and to make an ordinary macadamized road of sufficient depth to be durable under conditions of winter frost and spring mud means a heavy cost even for a narrow road. Besides, the loosening of the macadam surface by the sticky mud brought into it is a constant difficulty.

With a concrete road, a depth of only 5 to 6 in. is sufficient, and the material well laid is proof against both frost and mud conditions. For a large part of these agricultural districts, only a narrow road is necessary save for a few main thoroughfares. An 8-ft. strip of concrete will enable the farmer in his automobile or buggy to go to town in the worst of the mud season. A dirt road alongside will be used in preference to the concrete by a large portion of the traffic during two-thirds of the year. If the concrete can be laid down at a cost of a dollar a square yard, a roadway 8 ft. wide will cost about $4700 per mile. Such a roadway may not be ideally perfect; but it will be an enormous boon to those who live along it during the annual mud blockade, and at present, it seems to promise better results at a moderate cost than any other type of permanent road.

Letters to the Editor

A Question in Sewage Disposal

Sir—The problems connected with the disposal of sewage discharged through an intercepting sewer are of great importance and are often given insufficient attention by the engineer. This is particularly true as regards capacities of pumping stations and treatment works.

In cases where the sewage is to be pumped and treated, and especially where the effluent is to be discharged into the same stream or waterway receiving the discharge from the storm-water overflows, a general principle of the design accepted by some engineers is as follows:

The ultimate capacities of the intercepting sewer, pumping equipment and treatment works should be the same.*

The connections to the interceptor should be so constructed that the maximum flow carried by the interceptor will have the same ratio to the ultimate capacity of the interceptor that the dry-weather flow has to the ultimate dry-weather flow forming the basis of the design. Should not the pumping equipment and treatment works be of sufficient capacity to care for the maximum flow of the interceptor thus determined and should not these capacities be enlarged as the population tributary increases until the ultimate population of the interceptor is reached? Again, is it not illogical to provide a capacity for the intercepting sewer in excess of the volume ultimately to be pumped and treated?

W. H. Dittoe,
Chief Engineer, Ohio State Board of Health.
Columbus, Ohio, Jan. 30, 1914.

*This does not necessarily mean that all of the mixed sewage and storm water carried by the intercepting sewer must receive the same treatment provided for the dry-weather flow but during the early period of the excess flow, at least, it should not be discharged without some treatment.

Underground Waters in Elevated Lava Deposits

Sir—An article in Engneering News of Nov. 20, 1913, described the disappearance underground of seepage water which had collected in a foundation pit being dug near Spokane. This phenomenon is not at all uncommon in elevated districts which have been subject to violent volcanic action during comparatively recent geologic periods.

Fig. 1. Crater Lake, Ore.: A Natural Water-Tight Tank under 2000-Ft. Head

(Permission to use this view given by courtesy of the Miller Photo Co., of Klamath Falls, Ore. The top of the cinder cone in the middle distance is 900 ft. above water.)

Such an area, with a general elevation approximating 4000 ft. above sea level, comprises about 100,000 sq.mi. in northeastern California, central and eastern Oregon, together with parts of Nevada, Idaho and Washington. Portions of this great territory are covered with successive lava flows, scores of them, aggregating hundreds or perhaps thousands of feet in thickness. In addition

to being belched forth from craters, much of this lava appears to have been erupted from longitudinal fissures extending often for miles across the surface of the country. The soil cover is quite shallow as a rule, and in places the last lava flow is almost unchanged in appearance since first cooling. Cellar excavations in the vicinity of the writer's home have uncovered deposits so recent as to be uncomfortably hot to the touch, while boiling springs are of very frequent occurrence.

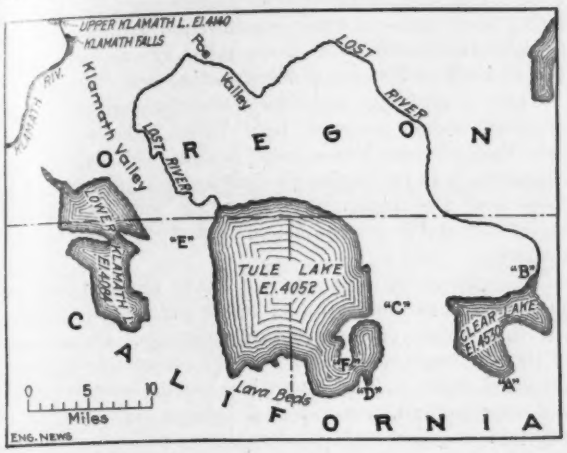


FIG. 2. OBSERVATION POINTS FOR STUDY OF UNDERGROUND WATERS IN LAND SURROUNDING LAKES IN LAVA-DEPOSIT AREA NEAR CALIFORNIA OREGON STATE LINE

Under conditions such as these the occurrence or loss of underground water cannot be predicted in advance. For example, upon the Deschutes River, in central Oregon, there is a place where the measured discharge is very much less than it is at a gaging station several miles upstream from the first one; also upon one of the main canals of a large irigation project near Bend, Ore., great difficulty has been experienced from heavy losses through certain sections of the canal which were located in rock excavation. On the other hand, there is a wonderful extinct crater, located in Crater National Park, about 60 miles northerly from Klamath Falls, Ore., in whose bowl-shaped depression lies Crater Lake (Fig. 1). The surface of this lake is at Elev. 6100 ft. (approx.) above sea level. It is nearly circular in shape, about six miles across, while a considerable proportion of it is close to 2000 ft. in depth. The sides of the crater above the lake rise precipitously for from one to two thousand feet, so that the drainage area is but little more than the water surface area. The precipitation occurs principally as snow, the total fall of which is probably from 10 to 15 ft. per annum, and this can easily be balanced by evaporation from the water surface of the lake. Notwithstanding the fact that this immense mass of water is almost wholly above the general level of the surrounding country 10 or 15 miles to the south and east, yet it is reported that the surface level of the lake has remained practically at a constant elevation since the lake has been known to the white men. About 15 miles to the south of the lake, where the ground level is at Elev. 4160, there are a few small flowing artesian wells, and this is the only indication of the enormous hydraulic pressure originating in Crater Lake, if we except a few streams arising from springs upon the mountain slopes, such as are customary under similar conditions of high mountain slopes subject to heavy precipitation.

The accompanying map (Fig. 2) shows a number of lakes near the California-Oregon State line regarding which some interesting data have been collected concerning the presence or absence of underground waters in the adjacent lands. Lost River rises in Clear Lake, and after flowing for about 70 miles through a circuitous route discharges into Tule Lake, which is nearly 500 ft. lower than Clear Lake although distant from it only five miles in an air line. The discharge of Lost River varies from 100 to 10,000 sec.-ft., and in prehistoric times it must have had a free outlet to the south into Pitt River. Successive lava flows have blocked this outlet, so that there is now a basaltic barrier south of Tule Lake for many miles and at an elevation several hundred feet above the present lake surface. Since the time of the first white settlers, about 60 years ago, the lake surface has raised 18 ft., flooding 35,000 acres of good agricultural land, which the United States Reclamation Service is now seeking to reclaim by a combination of diversion, storage and evaporation.

Several years ago, when the lake was near its maximum elevation, the writer made a careful search along its southerly shore hoping to find some evidence of the location of the former outlet. The result was generally negative, although at a point about half a mile south of the middle of the shore line a depression was found covering several hundred acres, the dry floor of which

FIG. 3. VERTICAL FACE OF PIT USED FOR STUDY OF UNDERGROUND WATER FLOW FROM TULE LAKE, CALIFORNIA

(The pit was drained for the purpose of taking the view. This and a second pit developed on outflow of 30 sec.-ft. for three years.)

was 14 ft. below the lake surface. At the point marked "*D*," however, range riders had noticed a marked surface flow into the foot of a rocky bluff, and some development work had been done with a view to increasing the flow. Additional work was done by the writer, and in two pits, each about 30x80 ft., by 18 ft. deep, measuring weirs and check gates were installed which showed a flow underground away from the lake amounting to about 30 sec.-ft. continuing for a period of three years. The small tunnel (about 4x5 ft.), shown at the bottom of the view, was not effective, as most of the discharge was found to take place in the upper 4 ft. of the excavation, through vertical shrinkage cracks, similar to that marked "*X*." Additional seepage undoubtedly occurred along planes of contact of different lava flows, similar to that

shown at the level of the base of the slab over the roof of the tunnel. The cracks in the lower portion of the excavation were found to be very generally more or less choked by shells and floating trash, so that after the surface of the lake had subsided about 4 ft., the underground flow through these pits had practically ceased.

During the progress of the work near *"D,"* several wells were dug in an effort to get water for camp use, as the lake water while fresh contains excessive growths of microscopic algae to an extent making the water unfit for domestic use. Wells about 30 ft. deep below lake level were sunk on the edge of sandy beaches at *"D"* and later at *"F,"* and although the excavation was not in rock at any point yet the wells remained perfectly dry.

The writer has had construction camps at points *"A"* and *"B,"* and in each case attempts to get well water for domestic use were abortive; three wells having been sunk near *"A"* and one at *"B,"* each far below and adjacent to large bodies of standing water. A driven well at *"E"* did not yield water until reaching a point 100 ft. below the level of Tule Lake, and then the water was warm and saline, and evidently had no connection with either of the adjacent lakes.

A cattleman living at *"C,"* whose ranch is more than 100 ft. below the level of Clear Lake, has been trying for more than 20 years to get well water. He has dug 11 wells from 95 to 120 ft. in depth without finding any water. He reports that after penetrating a few feet of soil he finds about 20 ft. of rock in which the seams and fissures are filled with soil, but below that depth in every instance the basalt has many open fissures, some of which are wide enough to permit inserting a man's arm. If these conditions are typical is it any wonder that underground water is hard to find in this part of northern California?

It appears that for both Clear and Tule Lakes the conditions are such that the slope of the ground water is away from rather than toward the lakes. An exception may be noted in the case of the north shore of Tule Lake and Klamath and Poe Valleys and Lower Klamath Lake. These areas are underlaid by a deposit of diatomaceous ash several hundred feet in thickness. This deposit is indurated to an extent that makes it difficult to plow, and it is almost absolutely water-tight, although when dried out large blocks of it are so light that they float in water. Shallow wells in this material generally collect some surface water, while deep bored wells penetrating through the deposit usually discover water underneath, but of a quality frequently unfit for use.

The scarcity of underground water in this region probably is due to the great depth of freshly cooled lava, which is fissured in all directions, combined with the elevation which gives excellent opportunity for drainage through these fissures. The surface cover of soil is as yet thin, and under conditions of scanty rainfall it has not had time slowly to penetrate and fill underground crevices to any great depth.

W. W. PATCH.

(Formerly Engineer, U. S. Reclamation Service.)

Klamath Falls, Ore., Dec. 20, 1913.

Publicity for the Engineer

Sir—I have read with interest the communication by C. E. Drayer in your issue of Jan. 22, and also your editorial comments on the subject. As a former president of the Cleveland Engineering Society and one of its honorary members, I feel additional interest in the work of the publicity committee.

There has been a feeling among engineers, especially those well up in the profession, that it was a dignified profession and that whatever savored of advertising and of the methods of manufacturers and shopkeepers was beneath its notice.

This is a day of advertising and people read the papers to find out what is being done and what is being bought and sold. Lawyers and doctors are not averse to seeing their names in print in connection with noted legal or medical achievements. Even the clergy does not hesitate to avail itself of the publicity afforded by the press.

There is no longer any reason why the engineer or the architect should hide his light under a bushel. "Let your light so shine before men" is still good advice. Furthermore, it is the engineer's duty to keep the public informed of the important engineering works which are under way and to give reliable data as to their merits and demerits.

The average citizen is more or less at the mercy of the press as regards the status of municipal projects involving the services of engineers or architects. On account of the ignorance or willfulness of the reporter, he may get distorted ideas concerning various public improvements. An unprejudiced, non-technical opinion coming from a reputable engineer or body of engineers will appeal to the average citizen and enable him to talk and vote intelligently.

Naturally, experts do not always agree, and there may be two sides to an engineering problem, each having its champions. What harm is there in presenting both sides to the public through the columns of the press and let the public decide for itself? The citizen may not have technical knowledge; but if he is a fair representative of his class he does appreciate an argument and has a certain code of ethics which will enable him to decide intelligently.

Publicity in all business is the great purifier and this is just as true in technical as in commercial problems.

Unfortunately, too many of our best engineers cannot tell what they know. They can talk to a contractor and make him understand; but they cannot "tell a story for the public." Therefore, such an arrangement as Mr. Drayer describes is an ideal one. The convincing manner in which he tells his story accounts for his success as publicity manager for the society.

I wish that more attention were given in our technical institutions to writing of the journalistic sort. Such instruction in English as many engineering students get is not of a kind to help them in "telling the story." Writing essays of the stereotyped sort and reading the masters of English literature are well enough in their way but do not help the student to express clearly his ideas on technical subjects.

Of the two, however—the engineer trying to write a newspaper description of something he understands; or the reporter confidently describing something he does not understand—commend me to the former.

Once in Cleveland a reporter came to write up some experiments I was making which had to do with the bursting of cast-iron flywheels. After contemplating a 10-ft. wheel for some minutes he solemnly inquired why manufacturers were not compelled to temper all flywheel rims. Then I began my explanation all over again.

A prominent weekly magazine recently started a page on new inventions. I do not know who edited it. Its literary style was good but some of the statements made very humorous reading for an engineer.

In view of all this, I believe the Cleveland plan is an excellent one. Accurate, impartial statements about engineering projects, simply written and, if necessary, trimmed and embellished by the editor so as to have the right sound, can do much to benefit the profession and to educate the public.

C. H. BENJAMIN.

Dean of Schools of Engineering, Purdue University, Lafayette, Ind., Jan. 31, 1914.

Mr. Wegmann's Relation to the Stony River Dam

Sir—In your issue of Jan. 22, 1914, you published an article by G. H. Bayles, M. Am. Soc. C. E., describing the construction of the Stony River Dam, in West Virginia. On another page of the same issue there appears an account of the failure of about 75 ft. of this dam. As Mr. Bayles' article gives my name as "Consulting Engineer" in connection with this work, permit me to say that my services consisted only in advising the West Virginia Pulp & Paper Co. what kind of a dam to build and in preparing the contract and specifications.

The site selected for this dam on Stony River, West Virginia, was on top of a mountain, about 3000 ft. above the sea. The construction of a solid masonry dam was out of question, as it would have cost about $500,000. There was no suitable material for an earth dam near-by, and so the choice of dam was restricted to some type of hollow reinforced-concrete dam.

Four construction companies were invited to submit designs and bids for building such a dam (see ENGINEERING NEWS, Sept. 5, 1912). Only one of these companies, viz., the Ambursen Hydraulic Construction Co., of Boston, Mass., had had extensive experience in building such dams. About 70 Ambursen dams had been constructed in various parts of this country and Canada and no failures had occurred.

The West Virginia Pulp & Paper Co. paid the Ambursen Co. a liberal fee for designing the dam and for any patent rights which it might own. As the bid of this company for constructing the dam was too high, the contract was awarded to Fred G. Webber, of New York, who was to receive a lump sum for building the dam according to the plans of the Ambursen Co. and an additional payment per cubic yard for excavation and masonry where the engineers ordered the cutoff wall built deeper than shown on the plans. This was left for the engineer of the paper company to decide according to developments. To insure that the work would be well executed, the paper company engaged one of the engineers of the Ambursen Co. to be constantly on the ground during the construction, in addition to its own resident engineer.

My connection with the work ceased before the contract was signed, which occurred before the plans prepared by the Ambursen Co. had been received. I made only one visit to the site of the dam. This visit was preliminary to my recommendations. The paper company did not request me to make any further visits. I did not see the site after construction began.

From what has been stated above, it will be seen that the West Virginia Pulp & Paper Co. did everything in its power to have the Stony River Dam properly designed and built.

EDWARD WEGMANN.

New York, Feb. 7, 1914.

NOTES AND QUERIES

On page 262 of our issue, Jan. 29, in the report of the annual meeting of the American Society of Civil Engineers, in the 13th line from the bottom of the second column, it is stated, "Mr. Hovey and others spoke against the motion. . . ." This is an error and should have read, "H. W. Hodge and others . . . ."

A correspondent who is in immediate necessity of answering the problem is anxious to know the effect of sauerkraut on concrete.

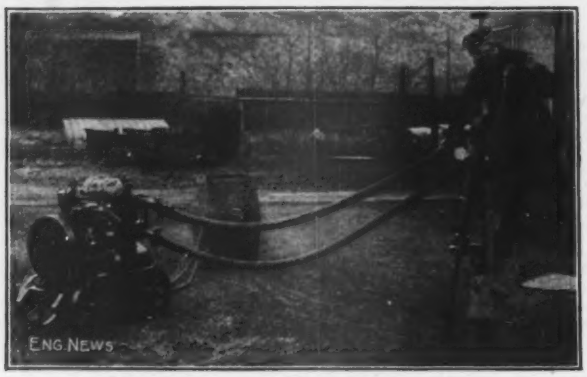
Electric Traction Plans of the Chicago, Milwaukee & St. Paul for its Mountain Division in Montana have been advanced over the announcements made in "Engineering News," Jan. 16, and Dec. 25, 1913, so that the following details are available. There will be at first twelve 200-ton freight locomotives, four 200-ton express passenger locomotives and two 100-ton local passenger locomotives with a few electric switchers. On the first two types, the equipment will be arranged for regenerative braking to return to the line some 50% of the energy required in up-grade hauls. The through-passenger locomotive is designed to pull a ten-car, 1000-ton passenger train at 24 miles per hr. on a 2% grade. The local-passenger locomotive will be able to haul a 300-ton train at 42 miles an hour on level. The scheme of heating the passenger cars has not been decided on. If the passenger locomotives are built for running from one end only, there will be space for a small heating boiler, but if double-end control of these locomotives is finally adopted individual car heaters will have to be used after the practice on the neighboring Butte, Anaconda & Pacific Ry., which operates by a similar systetm. The freight locomotives are designed to haul a trailing load of 2500 tons on a 1% grade at a speed of 15 miles per hr., one locomotive being used on grades up to 1% and two between that and 2%, maintaining the same speed.

An overhead catenary-type trolley will be supplied from five substations. The contract with the Great Falls Power Co. provides for delivering energy at seven points along the wider limits of the ultimate electric zone, but these do not all coincide with the proposed substations. Therefore, there will be a continuous transmission line following the right-of-way, except for cut-offs at sharp curves. Single-pole bracket suspension will be used generally for the contact wire. The poles will be of wood, guyed at curves. For spans of two to four tracks and for sharpest curves cross-catenary supports will be thrown across between wood poles. For span of more than four tracks, the span wire will run between steel poles. The clearance between conductor and rail will be 24 ft. The track will be bonded and in addition a No. 0000 return feeder will be used, carried on top of the trolley poles, serving also as a ground wire for lightning protection.

The substation capacities have been arranged to provide energy so that locomotives may be started at full effort on grades, accelerating at the rate of 0.15 mile per hour per second. To this end, where the line has a gradient greater than 1% (in three places) the substations will have three 1500-kw. motor-generator sets, one being a reserve. For grades less than 1%, the substations will house two such units, one in reserve. Each motor convertor will comprise a 60-cycle synchronous motor direct-connected to two 750-kw. 1200-volt direct-current generators in series for the 2400-volt service. Three single-phase step-down transformers are to be interposed between the motor-generator and the 100,000-volt line. Each set will have its own exciter. Starting under maximum load and grade will impose 100% overload on two converter units, and these will be built to operate at 200% overload for five minutes. In emergency the locomotive can be operated with its motors in series so that they will start at low speed and half demand. It is reported that the contract provides a peak-capacity supply of 20,000 kw. at present and a 40% load factor. To limit peak loads the train dispatcher will also control the power load by regulating train speeds, delaying trains at the foot of grades and dispatching at favorable hours.

A Gasoline-Engine-Driven Air Rock Drill*

A type of drill has been in use for some eight years, comprising a pulsating compressor and drill engine working in a closed system. As first brought out, the pulsator was driven by an electric motor (see ENGINEERING NEWS, July 26, 1906); a modification has now been designed in which the motor is replaced by a 6-h.p. single-cylinder gasoline engine.



GASOLINE-ENGINE AIR ROCK-DRILL OUTFIT

As shown in the accompanying figure, the engine fuel-supply tank and pulsator are all mounted on a four-wheel truck for easy transportation, making the device best adapted for locations where electric power is not possible or advantageous. The fuel consumption is reported to be about 2 qt. of gasoline per hour; the supply tank, surmounting the engine holds 1¼ gal. The main bearings have grease cups and the piston and crankpin are splash oiled. Circulating water for the engine jacket is obtained as may be most convenient.

The drill is of simple type—having a cylinder and drill-rotating device but no valves, springs, side rods, etc. The cylinder is larger than in the corresponding air drill, but the piston is shorter so that the weight of a drilling unit is about the same. Air from the pulsator (a double-acting valveless compressor) comes alternately above and below the piston, there being two short hose connections. This air is never exhausted but plays back and forth between drill and pulsator. This last machine has no water jackets and is driven through gearing.

Length of stroke is varied by cranking the drill closer to or farther from the work. The drill will operate under the smallest clearance between drill point and rock, since there are no valves dependent for throw on piston travel. The cushioning at each end of a stroke is such that the piston strikes neither head. The drill can be backed out of bad rock while running; unlike the ordinary drill, when the steel sticks, the pulsations on the piston tend to loosen it.

The drill cylinder is 4¾ in. in diameter, and the stroke is 7 in. Octagon steels are accommodated from 1 to 1⅛ in. diameter, and for holes up to 12 ft. deep. The feed is 24 in. and the number of strokes 440 per minute. The machine shown is built by the Ingersoll-Rand Co. of New York City.

*From information furnished by the Ingersoll-Rand Co., 11 Broadway, New York City.

A $20,000,000 Chinese Flood and Famine Prevention Project

The large flood and famine prevention works in the Huai River Valley, China, recommended by Charles Davidson Jameson, American Red Cross Engineer to China, after careful study, are to be carried out by the J. G. White Engineering Corporation, 43 Exchange Place, New York City, in case the Chinese government, with the aid of the corporation named, is able to dispose of $20,000,000 of bonds to finance the project. The bonds have been authorized by the Chinese Government, to be expended under the general direction of the American Red Cross, and the latter has designated the corporation named as engineering, construction and financial agent for the execution of the work.

A long abstract of Mr. Jameson's report on this problem, accompanied by a map of the flood and famine district, and a number of halftone views, was published in our issue of Sept. 25, 1913. Mr. Jameson advised permanent flood-prevention works in place of the temporary works on which the Chinese government has spent large sums yearly—without preventing famines which have resulted in the philanthropists of the world pouring millions of dollars into China to afford partial relief. The area involved is 17,000 square miles, on which "the farmers do not average more than two crops in five years, where, if the floods were eliminated, the normal condition would be two large crops each year."

The following information regarding the present status of the project is taken from a statement just issued by the J. G. White Engineering Corporation:

The whole enterprise depends upon the ability of the Chinese Government to find a market for the proposed bond issue. It is anticipated that there will be no difficulty in this connection, and the prospect is that American money, as well as American engineers, will be largely involved.

Dr. Chen Chin-Tao is now on his way to America to represent his country in the negotiations, and five distinguished engineers will be assigned to confer with the J. G. White Engineering Corporation and Dr. Chen Chin-Tao, and proceed to China, in time to observe the next overflow of the Huai River, which generally occurs in July.

The work will require approximately six years to complete, and employment will be given to about 100,000 men. The project will involve dredging to deepen the channel of the river and the Grand Canal; also the construction of dams and reservoirs to keep the Huai in its proper course, and to impound its surplus water and divert the streams flowing into the Huai, which, at the time of floods, greatly increase its overflow. The Huai River, for the greater part of its length, flows between banks that are elevated above the surrounding country, and in times past the river in overflowing its banks, has changed the geography of an entire Province over night. During one of the flood periods, the Yellow River, which is a tributary to the Huai, switched the location of its mouth a distance of about 700 miles.

It is the plan of the Chinese Government to pay the principal and interest of the proposed $20,000,000 bond issue, from taxes to be levied on the lands that will be benefited in the flood district, and also from rentals and the sale of about one million acres of land, which will be reclaimed.

The outcome of this great project will be watched with interest by engineers throughout the world.

⌘

An Engineering Competition is advertised in "London Engineering" by the Chilian government, covering complete designs and estimates for the main model workshop and four auxiliary repair shops of the Chilian State Railways. A first prize of $20,000 is offered for the best scheme with a second prize of $10,000 and several honorable mentions. Plans are to be delivered to the Ministry of Railways, Santiago de Chili, before May 1, 1914. A Special Commission will examine them and award the prizes.

The Eighteenth St. Sewer Explosion at Detroit

By Robert H. McCormick*

On Jan. 28, an explosion from some unknown cause occurred in the 18th St. sewer. This sewer runs in a northeasterly direction through 18th St., Buchanan St., Calumet and Canfield avenues and Cass Ave. to the Boulevard, a distance of five miles. The portion of the sewer from the river to Fort St. is comprised of two 5-ft. cylinders running under the tracks of the Wabash Railroad. From Fort St. north for a ways is an 8-ft. cylinder.

The explosion occurred about 3 p.m. and could be traced from the river to a point about 3½ miles north (see map). Manhole covers along the whole line of sewer were blown off and broken. The greatest damage was done on the shallow portion of the sewer at the Wabash Railroad Yards, where one of the barrels was completely destroyed, and at the Michigan Central Railroad Subway, where the paving of the subway comprised the roof of the sewer, and where the sewer was destroyed for a distance of 100 ft. A portion of the sewer in the subway was a 7-ft. cylinder, composed of three rings of brick. The arch of this portion was blown completely off. Another portion of the sewer at the subway was a special horseshoe section with a concrete slab on top. This slab was lifted bodily and shoved to one side.

At the corner of Calumet and Grand River avenues the fronts of three small stores were blown out. In addition, numerous manholes were shattered and will have to be rebuilt.

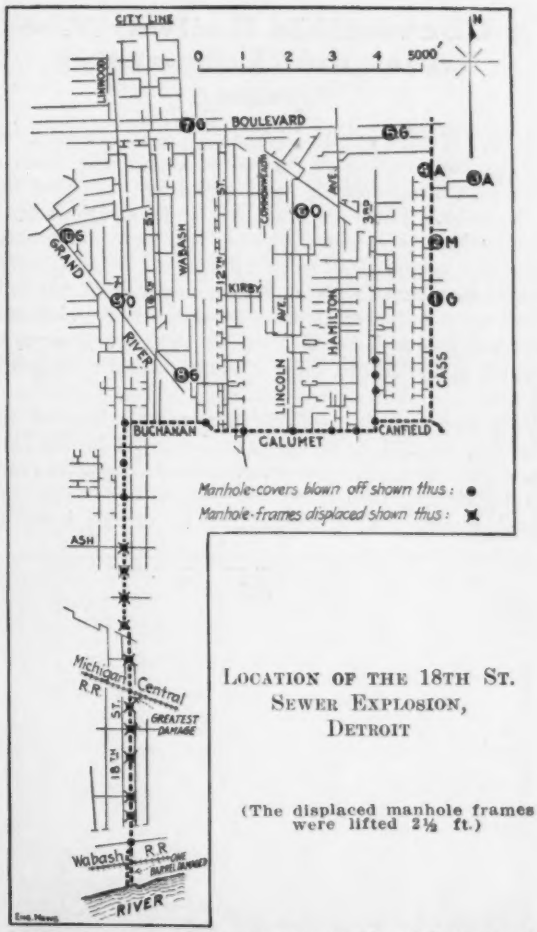
Clearing up After the 18th St. Sewer Explosion at Detroit

The total damage done to the sewer will probably be between $6,000 and $7,000.

The cause of the explosion is, at the present time, unknown, although there is little doubt but what it was caused by the presence of gasoline in the sewer. A thorough canvass of the drainage territory tributary to this sewer has shown that in it there are quite a number of small garages and automobile factories and one oil company which handles immense quantities of gasoline.

The débris and obstructions in the sewer caused by the explosion were removed inside of 24 hours and the normal flow of the sewer was restored. No effort to repair the damage done to the sewer will probably be made until spring, a temporary covering of plank having been placed over it.

*City Engineer, Detroit, Mich.



Location of the 18th St. Sewer Explosion, Detroit

(The displaced manhole frames were lifted 2½ ft.)

The large round dots numbered 1 to 10 and lettered, also G, A, M and O, indicate, respectively, garages, automobile factories, motorcycle factories and oil stations, as follows:

Garages:	1022 Cass Ave.	1 G
	124 Milwaukee Ave. West	5 G
	14th St. & Gd. Blvd.	7 G
	1374 Grand River Ave.	10 G
	14th St. & Forest Ave.	8 G
Auto Factories:	Cadillac Motor Co., Amsterdam & Cass Ave.	4 A
	Studebaker, Piquette & John R St.	3 A
Motorcycle Factories:	Henderson, 1158 Cass.	2 M
Oil Stations:	Sun Oil Co., W. of Brooklyn Ave. & S. of M. C. R.R.	6 O
	Auto Station, Linwood & Gd. River Aves.	9 O

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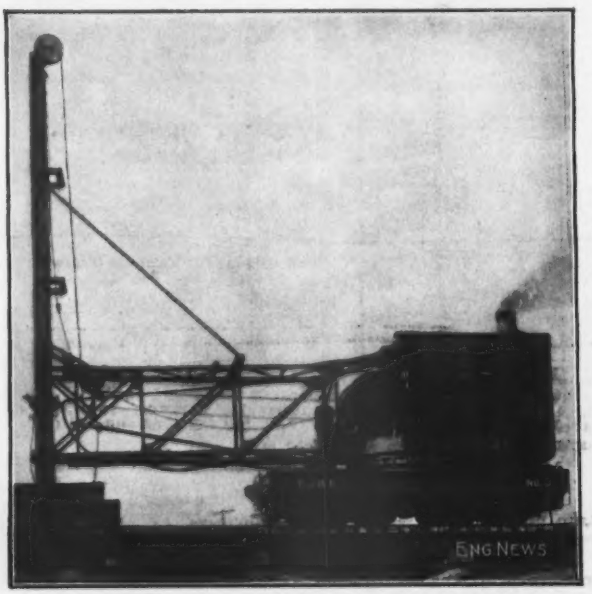
A Cave-in Over a Sewer occurred recently in Baltimore, Md., but the sewer did not collapse, as was reported. We are indebted to Calvin W. Hendrick, chief engineer of the Sewerage Commission of Baltimore, for the following information on the subject:

The cave-in was over the old Harford Run Sewer, which is a 10-ft. sewer built about 25 years ago. The parties who constructed the sewer state that a great deal of fine sand was encountered when the sewer was constructed at this point, in tunnel. Appearances indicated that in tunneling ground was lost, leaving voids above the timber work. The seepage of water through the ground finally caused the cavity to work its way to the street surface, and a section of the street bed dropped. The hole has been refilled.

A Convertible Railway Pile-Driver and Locomotive Crane

A type of railway pile-driver which is in extensive use, has the leads carried at the end of a revolving truss, so as to have a considerable reach ahead and on either side of the track. These machines are built by various firms, each having its special features. In some designs the boiler and engine revolve with the truss, while in other designs they remain stationary on the deck of the pile-driver car. A powerful machine of the latter class was described in our issue of Nov. 18, 1909, while a recent machine of the former class is shown in the accompanying cut.

This new machine differs from most others of the same type in that its service is not confined to pile-driving, since it is readily convertible into a locomotive crane and can then be used either for hoisting or for handling a grab bucket. This adaptability to various kinds of



A Convertible Railway Pile-Driver and Locomotive Crane

work makes the machine available for the smaller roads and divisions as well as for those requiring a large amount of special equipment. While locomotive cranes have been used in many cases for pile-driving by fitting leads at the end of the boom, the makers of this machine believe that carrying the leads on the revolving truss makes a more satisfactory pile-driving machine.

The engine and boiler are mounted on a frame carried by the turntable, and at the forward end of the frame is attached the horizontal truss carrying the 40-ft. leads. The machine illustrated can drive piles at a distance of 20 ft. 6 in. from the forward axle or 29 ft. from the center line of the track, but the truss can be built to any desired length. The leads revolve on pivot pins at the top of the end posts of the truss. To lower them, the lock pin which secures the leads at the lower chord is withdrawn and the steam hammer is then raised above the pivot pin so as to overbalance the leads, which then (under control of the lines from the drum) fall back to a horizontal position. They can be raised or lowered in about 20 to 30 seconds. For driving batter piles, the leads may be made to swing laterally.

There is one drum for handling the hammer line and another for the pile line, while in front of the drums is a countershaft carrying two independent nigger-heads, each operated by a jaw clutch and ratchet. The machine is mounted on four-wheel trucks having cast-steel frames and bolsters and 33-in. rolled steel wheels. It weighs about 90 tons, and is equipped with air brakes and a brake pump.

A special feature of the machine is that it can be converted to a crane by removing the horizontal truss and placing a boom in its place. This can be done in a short time by disconnecting the pins at the ends of the bottom and top chords, and fitting the heel of the boom to the bottom pins. The hoisting capacity is 30 tons. Telescopic outrigger beams are fitted at the middle and ends of the car frame, and with these adjusted the boom can handle a load of 15 tons at 35-ft. radius or 60 tons at 13-ft. radius. An electric generating set and 54-in. electromagnet are provided for use in handling rails or scrap.

One of the machines was in use for about two months on the reconstruction of a bridge on the Elgin, Joliet & Eastern Ry., at North Chicago, Ill. The pile-driver attachment was used in building a temporary bridge. The boom attachment was used in taking out the steel of the old bridge and handling that for the new structure, and was used also in operating a grab bucket for excavation and backfilling.

Without this convertible machine it would have been necessary to employ a work-train every day. The operating department would charge the bridge and building department about $50 per day for such equipment, so that the saving is considerable, in addition to which the machine was on the ground all the time. Formerly a work train with wrecking crane had to be obtained for handling bridge girders, but in this case it was necessary only to have a wrecking crane to assist in placing some 57-ton girders 116 ft. 7 in. long, the new machine (as a locomotive crane) handling one end of the girders. With the grab bucket also it handled 900 cu.yd. of backfilling at the abutment in a 10-hr. shift.

This convertible railway pile-driver and locomotive crane is built by the Orton & Steinbrenner Co., of Chicago.

NEWS NOTES

A Conference on the Irrigation Situation has been suggested by Secretary of the Interior Lane in a letter sent to the governors of 11 states in the irrigation section of the United States. In the course of his letter Secretary Lane wrote:

> It appears that no further large development can now be expected unless it is (a) by the use of public funds, state or national, upon which no profit or interest is required, or (b) by the use of funds procured by taxation, as in the case of irrigation districts and where also the question of profit and interest on the works themselves is secondary to the gain which comes to the whole community through the increased land values and the productivity of the soil.

A Continuous Wood Stave Pipe Line is to be built for the Rutland Railway, Light & Power Co., of Rutland, Vt., by the Pacific Tank & Pipe Co., of Portland, Ore. The staves will be of fir. The pipe line will be 5 ft. in diameter and about 10,000 ft. long, and will be under 80-ft. head at the lower end, where it joins a steel stand-pipe. From the stand-pipe to the power house steel pipe will be used. W. S. Barstow

& Co., 50 Pine St., New York City, are engineers for the Rutland company named above, and H. D. Coale, Portland, Ore., is chief engineer for the contracting company.

Col. George W. Goethals, Corps of Engineers, U. S. A., was appointed by President Wilson on Feb. 3, 1914, Governor of the Canal Zone. The appointment was later confirmed by the Senate.

The New Generating Station of the United Electric Light & Power Co., at 201st St. and Harlem River, New York City, was opened officially on Jan. 31. George B. Cortelyou, President of the Consolidated Gas Co., of New York City, delivered an address. The building, of brick and concrete, has a frontage on 201st St. of 330 ft., an average depth of 200 ft., and a total superficial floor area of 200,000 sq.ft. The main turbine room contains three 15,000-kw. turbine-driven generators of the high-speed, double-flow type. The room is equipped with a 75-ton traveling crane. Thirty-two 650-hp. Babcock & Wilcox boilers have been installed in the boiler house on the first-floor level, and provision is made for an equal number on the second-floor level. The coal tower, 240 ft. high, is located on the bulkhead line; coal is hoisted from barges, dumped into a hopper, carried thence through a crusher from which it passes to coal cars for weighing. A cable road then conveys it to the bunkers.

Disinfection of the Water-Supply of Buffalo, N. Y., has been recommended by Rudolph Hering, consulting engineer, New York City, in a report submitted to Francis G. Ward, Commissioner of Public Works. Mr. Hering suggests that alternative bids be received for disinfection by hypochlorite of lime and by liquid chlorine. Mr. Hering's opinion is that disinfection is all that is needed for the safeguarding of the water-supply, but that if the people are willing to pay the extra cost of insuring for themselves a water clear at all times, a filtration plant would be desirable. The supply, as now taken from a new intake in the Emerald Channel at the foot of Lake Erie, is turbid for three or four weeks in the year and somewhat clouded for a total of two to three months owing to wave disturbances which stir up clay and sand from the bottom of the lake. In any event, Mr. Hering recommends that the city buy land for a filtration plant, which sooner or later is bound to be provided.

A Flagman Sentenced. Sentence Suspended—The flagman of the Bar Harbor Express, which was wrecked by the White Mountain Express on the New York, New Haven & Hartford R.R., at North Haven, on Sept. 2, 1913, with a loss of 21 persons, was sentenced to one year in the county jail, by Judge Stumway, of the Superior Court, in New Haven, but the sentence was suspended. Charles H. Murray, the flagman, had pleaded guilty of manslaughter after a coroner's finding of criminal responsibility. Just before the wreck occurred, Murray went back to flag the second section, known as the White Mountain Express; but he had gone but a short distance when the latter passed him. The state contended that he had not gone back far enough in the performance of his duty. In pronouncing sentence the judge said that he had read the report of the Interstate Commerce Commission and that among the contributory causes given for the wreck, the flagman's error was the least. The accident was described in "Engineering News," Sept. 4, 1913, p. 484, and Sept. 11, pp. 520 and 525.

The Smoke Prevention Section of the Sanitary Code of the Board of Health, New York City, prohibiting any factory from allowing a dense volume of smoke to issue from its plant, has been declared constitutional by the Appellate Division of the Supreme Court of New York State. The decision appears to reverse an earlier decision by a lower court, handed down a few months ago. The lower court held that the legislation was void because it was arbitrary, making no distinction as to the volume and time of smoke emission, and providing no standard to go by in determining whether or not a nuisance was created. The suit, which involves the New York Edison Co., now goes to trial as to the facts in the case, the company having entered a plea of not guilty of a violation of the sanitary code. If on trial the decision is against the company, it can appeal until it finally brings the matter before the Court of Errors and Appeals; whereupon the whole evidence would go before that court for consideration, including evidence as to the constitutionality of the section (81) of the sanitary code at issue.

New York State Canal Traffic during the calendar year 1913 is reported as follows by D. W. Peck, Supt. of Public Works:

During the season, 2,602,035 tons were carried on the canals, made up of 2,037,358 tons of way freight, and 564,677 similar ordinance on the ground that the proposed method of tons of through freight. The total tonnage eastbound was 1,980,517 tons, and the total westbound 621,518 tons. The tonnage per canal was as follows: Erie Canal, 1,788,453; Champlain, 554,892; Oswego, 61,554; Cayuga & Seneca, 149,874; Black River, 47,262. The canals opened between May 15 and June 13, and closed on Dec. 1.

In the same report, Superintendent Peck calls attention to the necessity for trained labor in the operation of the new locks and dams for the New York State Barge Canal which is being put into operation as it is completed. The old locks and dams of the Erie Canal were of a primitive sort which did not require expert attendance, but the latest developments and devices have been installed in the new works and their proper maintenance depends upon proper care. He recommends not only that expert labor be employed but that some provision be made to guarantee a reasonable tenure of office to the men who are appointed to these places.

Systematic Firing of Furnaces is the purpose of an Automatic Timer invented by Wm. T. Bonner, of New York City. The timer is an electrical instrument for producing in definite succession and at predetermined intervals a continuity of impulse which may be utilized for signaling purposes by the flashing of numbered lamps or the ringing of gongs or both, for indicating the periods at which certain duties are to be performed. The four essential elements of the apparatus are as follows: (1) A rotating lever pipe selecting switch for making connections across the different series of contact points. (2) A frequency drum operated through a high- or low-reduction gear train by a direct-current motor. (3) A sequence drum, constantly maintained by a compound spring motor in a condition of carefully calculated torque in turn controlled by a solenoid mechanism energized by intermittent impulse from the frequency drum. (4) The lamp signals, gongs, semaphores, or other signaling apparatus.

When this apparatus is used in directing the operations of a boiler plant it is first necessary to determine by tests or otherwise, the frequency with which the furnaces should be fired in order to produce the requisite amount of steam. The engineer can then indicate these requirements by setting the index of the selecting switch at the point which corresponds with this frequency. The apparatus then produces automatically the proper signals at any point required. The dial plate of the selecting switch is graduated over a range of from 45 seconds to 10 minutes. The Timer is also fitted with a mechanism by means of which the exact amount of fuel consumed or handled during any given period can be determined. The Timer is manufactured by the Timed Impulse Machinery Corporation, of South Brooklyn, and sold by the Merchant Engineers Corporation, 30 Church St., New York City.

Public Improvements at Philadelphia are contemplated on so extensive a scale as to bring the proposed bond issues to meet the cost up to a total of $26,400,000. Councils have just passed a bill for an $8,600,000 bond issue, authorized by popular vote in November, 1913. Another bill before one branch of the council calls for an election on Mar. 31, to vote on $12,800,000 of bonds, as follows:

Purpose	Amount
Art Museum	$1,500,000
Improvements, Philadelphia General Hospital	1,000,000
Parkway	1,000,000
Harbor and port improvements	1,000,000
Improvement of roads	1,000,000
Repaving and resurfacing streets	1,000,000
Toward completion of Northeast Boulevard	800,000
New bridges	650,000
New main sewers	600,000
New branch sewers	600,000
Toward completion of League Island Park	500,000
Grading streets	500,000
Payment of mandamuses for land taken for extensions to Fairmount Park	500,000
Sedimentation basin at Torresdale filtration plant	500,000
New recreation centers	300,000
New police and fire stations and apparatus	250,000
Toward building for Central Free Library	200,000
Improvement West Philadelphia water-supply	150,000
Improvement of county prisons	150,000
Restoration of Independence Hall, old City Hall and improvement of Independence Square	125,000
Park improvements	100,000
Pipe material, distribution service, Water Bureau	100,000
Toward erection of soldiers' and sailors' monument	100,000
Improvement of Cobb's Creek Park	100,000
Improvement of Fairmount Park	75,000
Total	$12,800,000

Still another bill before councils provides a $5,000,000 bond issue for the Broad St. Subway and for other improved transportation facilities.

The Orange-Montclair-East Orange Joint Sewage-Disposal Project has been at a standstill since Montclair passed an ordinance adopting the project (see "Engineering News," Aug. 28, 1913, p. 435). Recently the Mayor of Orange vetoed a

treatment (Imhoff tanks and sprinkling filters) has not been "demonstrated sufficiently to justify me in feeling absolutely safe in approving" the ordinance, and adding that immediate action did not seem imperative, since (1) East Orange had not yet adopted the ordinance and (2) it will be four or five years before the Passaic Valley Sewerage District will cease polluting the Passaic River, whereas the works proposed for Orange, Montclair and East Orange could be built in 18 months. An advisory sewerage committee recommended some time ago that the East Orange Council adopt the Orange-Montclair-East Orange project. Instead of doing so the project has been pending in the council while consideration has been given to a proposition submitted by the Sterilization Co. to design and build a sewage-treatment plant for East Orange. Recently three well known engineer-residents of East Orange (S. Whinery, C. C. Vermeule and Nicholas Hill, Jr) who were members of and had joined in the advisory committee recommendation just mentioned, declined to pass on the Sterilization Co. proposition because the chairman of the East Orange council is understood to be personally interested in it. These engineers have declared that even though the chairman should resign from the council before the contract he is advocating and in which he is personally interested may be made the whole proceeding is one which they cannot countenance even to the extent of passing an opinion on the merits of the system of sewage treatment proposed by the company named.

Great Activity in the United States Reclamation Service is indicated for the present year. An expenditure of $23,460,555 is proposed in a program which Secretary of the Interior Lane, on Jan. 30, instructed the Reclamation Commission to forward with all possible dispatch. The sum named will exhaust the bond loan resources of the Reclamation Fund, authorized by Congress in 1910. The proposed distribution of the fund is as follows:

Salt River Project, in the vicinity of Phœnix, Ariz., $909,846.
Near Yuma, Ariz., $831,126.
Near Orland, Calif., $255,700.
Grand Valley Project near Grand Junction, Colo., $1,873,184.
Uncompahgre Project, near Montrose, Colo., $750,861.
Arrowrock Dam and other features of the Boise, Ida., project, $3,600,057.
Minidoka Project, near Rupert and Burley, Ida., $476,874.
Huntley Project, near Billings, Mont., $281,000.
Milk River Project in the region tributary to Great Falls, Mont., $1,393,083; with an additional sum of $843,630 for the St. Mary Ctorage feature of the Milk River Project.
Sun River Project, in the vicinity of Simms and Fort Shaw, Mont., lying between Billings and Great Falls, $1,712,337.
Lower Yellowstone Project, near Savage, Mont., $103,800.
North Platte Project, comprising territory partly in the state of Nebraska and partly in the state of Wyoming, in the vicinity of Mitchell, Neb., $733,875.
Truckee-Carson Project in Nevada and California, near Lake Tahoe in the vicinity of Fallon, Nev., $807,706.
Carlsbad Project and Hondo Project, in the vicinity of Carlsbad, N. M., $304,000.
Rio Grande Project and the Elephant Butte storage works for the watering of lands lying between El Paso, Tex., and Las Cruces, N. M., $3,683,000.
North Dakota Pumping Project in the vicinity of Williston, N. D., $70,000.
Umatilla Project, near Hermiston, Ore., $572,000.
Klamath Project, in the vicinity of Klamath Falls, Ore., $175,219.
Belle Fourche Project, in the vicinity of the Black Hills, S. D., near the town of Newell, $163,039.
Strawberry Valley Project, in the vicinity of Provo, Utah, $686,641.
Okanogan Project, Washington, near the town of the same name, $149,000.
Several projects in the vicinity of North Yakima, Wash., a total of $1,380,739.
Shoshone Project, in the vicinity of the towns of Powell and Cody, Wyo., $593,399.
Preliminary investigations and the inauguration of new Reclamation enterprises in the West will involve the expenditure in Central Oregon and on the Columbia River of $472,916; $5000 in California; $10,000 in the state of Washington on the Palouse Project; $100,000 in Oklahoma in the vicinity of Lawton; $10,000 in Texas on the Pecos River; $50,000 for the exploration of the Colorado River basin and the determination of its resources in the matter of water storage and diversion sites; $50,000 in artesian experiments, the location of which have not yet been determined. The remainder of the $23,460,555 will be appropriated for townsite development and other related works.

PERSONALS

Mr. F. E. Phillips has been appointed Chief Engineer of the Coast Bridge Co., Portland, Ore., succeeding Mr. C. W. Raynor, Assoc. M. Am. Soc. C. E., resigned.

Mr. E. G. Tilton has resigned as Chief Engineer of the San Pedro, Los Angeles & Salt Lake R.R., which position he has held for the past 10 years.

Mr. H. E. Phelps, Assoc. M. Am. Soc. C. E., has resigned as City Engineer of Boulder, Colo., to become Assistant Professor of civil engineering at the University of Colorado.

Mr. John L. Vogel, Jr., Am. Soc. C. E., has resigned as Assistant Engineer of the Central R.R. of New Jersey to become Assistant Engineer of the Public Utility Commission of New Jersey.

Mr. L. W. Rundlett, M. Am. Soc. C. E., former Commissioner of Public Works of St. Paul, Minn., and since January, 1912, Commissioner of Public Works of Moose Jaw, Sask., has resigned.

Mr. Roy D. Tyler, Assoc. M. Am. Soc. C. E., formerly Division Engineer of Construction on the Lake Shore & Michigan Southern Ry., has opened an office as Consulting Engineer at Caspar, Wyo.

Mr. John Dickson, Master Mechanic of the Spokane, Portland & Seattle Ry., has been promoted to be General Master Mechanic, and the office of Superintendent of Motive Power has been discontinued.

Mr. J. Ansel Brooks, M. Am. Soc. M. E., Associate Professor of mechanics and mechanical drawing, at Brown University, has been given charge of the new course in industrial organization and management.

Mr. Benton R. Anderson, of Epworth, Iowa, has been appointed City Engineer of Carroll, Iowa, to take charge of considerable paving work now being done there. Mr. Anderson is a graduate of Ohio State University.

Messrs. C. C. Elmes, Road Foreman of Engines, and C. A. Bingaman, Engineer of Tests, of the Philadelphia & Reading Ry., have been appointed Assistant Engineers of Motive Power, with headquarters at Reading, Penn.

Mr. R. V. Reamer has been promoted from the position of Assistant Supervisor to be Engineer of Maintenance-of-Way of the Central R.R. of New Jersey, Central division, succeeding Mr. C. H. Stein, M. Am. Soc. C. E., promoted, as noted elsewhere.

Mr. Norman R. McLure, M. Am. Soc. C. E., formerly Principal Assistant Engineer of the Phoenix Iron Co., Phoenix, Penn., has been promoted to be Chief Engineer, succeeding Mr. D. W. Bowman, M. Am. Soc. C. E., resigned, as noted elsewhere.

Mr. E. O. Christiansen, Assoc. M. Am. Soc. C. E., has resigned his position with the United States Geological Survey to become Superintendent of Construction on the Northern division of the Waiahole Water Co. project, Island of Oahu, Hawaiian Islands.

Mr. B. J. Dalton, M. Am. Soc. C. E., Professor of Railway Engineering and Surveying at the University of Kansas, has resigned to become Assistant District Engineer, Division of Valuation, Interstate Commerce Commission, office of the Western district, Kansas City, Mo.

Mr. William Williams, a lawyer, and former Immigration Commissioner under Presidents Roosevelt and Taft, has been appointed Commissioner of Water, Gas and Electricity, New York City, to succeed Mr. Henry S. Thompson, whose term has expired. The salary is $7500 per annum.

Mr. Frank B. Scheetz, formerly Contract Engineer of the Kansas City Bridge Co., Kansas City, Mo., has been appointed Senior Structural Engineer in charge of the bridge and building department of the Western district of the Division of Valuation, Interstate Commerce Commission, Kansas City, Mo.

Mr. Clifton B. Spencer, formerly Office Engineer of the St. Louis & San Francisco R.R., at St. Louis, Mo., has been appointed Senior Civil Engineer in charge of the road and track department of the Western district of the Division of Valuation, Interstate Commerce Commission, Kansas City, Mo.

Mr. Francis H. Adams, formerly Engineer of Shop Extensions of the Atchison, Topeka & Santa Fé Ry., Topeka, Kan., has been appointed Senior Mechanical Engineer in charge of the mechanical department of Western district of the Division of Valuation, Interstate Commerce Commission, Kansas City, Mo.

Mr. John W. Meredith, recently Division Superintendent of the Central R.R. of New Jersey, at East Long Branch, N. J., has been promoted to be General Superintendent at New York City, succeeding Mr. C. W. Huntington, resigned, as noted elsewhere. Mr. Meredith is succeeded by Mr. Samuel B. Zartman.

Mr. Clark Dillenbeck, M. Am. Soc. C. E., Civil Engineer and Architect, Assistant Engineer of the Philadelphia & Reading Ry., Reading, Penn., has been appointed Engineer of Bridges, succeeding the late W. B. Riegner, M. Am. Soc. C. E. Mr. Dillenbeck is succeeded as Assistant Engineer by Mr. Otto Herold.

Mr. C. W. Huntington has resigned as General Superintendent of the Central R.R. of New Jersey, to become Vice-President and General Manager of the Minneapolis & St. Louis R.R., at St. Louis, Mo. Mr. Huntington began railway work at 19 years of age as a freight brakeman on the Chicago, Rock Island & Pacific Ry.

Mr. Morris McDonald, who was elected President of the Boston & Maine R.R., in July of last year, has resigned to devote his whole time to the Maine Central R.R., of which he is President and General Manager. Mr. McDonald was formerly Vice-President and General Manager of the Maine Central R.R., which is a subsidiary of the Boston & Maine R.R.

Mr. Morton Riddle, General Superintendent of the Atlantic Coast Line R.R., at Jacksonville, Fla., has resigned to become General Manager of the Florida East Coast Ry. Mr. Riddle was Assistant Chief Engineer of the Atlantic Coast Line in 1904 and 1905. Previous to that he had been Roadmaster and Division Superintendent. Since 1905 he has been General Superintendent.

Mr. J. Jorgensen, formerly Chief Engineer of the Hawaiian Irrigation Co., Ltd., Honolulu, H. I., has taken over the work of completing the Waiahole Water Co. project on a contract basis. This project comprises a 14,000-ft. main tunnel through the Koolau Range, on the Island of Oahu, and about 100,000 ft. of side tunnels and ditches, which are to supply the Oahu plantation with water for irrigation.

Mr. D. A. Watt, M. Am. Soc. C. E., United States Assistant Engineer, who has been Principal Assistant Engineer to Col. W. M. Black, Corps of Engineers, U. S. A., in charge of the First Engineer District, New York City, has been transferred to Albany, N. Y., to act as Principal Assistant Engineer to Capt. R. D. Black, Corps of Engineers, U. S. A., in charge of the government work along the Hudson River and on Lake Champlain.

Mr. C. A. Alderman, M. Am. Soc. C. E., has resigned as Chief Engineer and Vice-President of the Ironwood & Bessemer Ry. & Light Co., Ironwood, Mich., and has opened an office, temporarily, in Ashland, Wis., where he is engaged in investigating some small water-power developments. The work he has recently completed near Ironwood included the construction of a 2000-hp. hydro-electric plant on the Montreal River, a 7-mile interurban electric railway, and the improvements of the Ironwood water-works, described in "Engineering News" of Dec. 11, 1913.

Mr. John E. Sweet, Hon. M. Am. Soc. M. E., President of the Straight Line Engine Co., Syracuse , N. Y., was awarded the degree of Doctor of Engineering by Syracuse University at the recent midwinter meeting of the board of trustees. Dr. Sweet is in his 82d year. He was the son of a New York State farmer, and at 18 years of age was a carpenter's apprentice. Later he went South and established a business as an architect and builder, which he was obliged to abandon at the outbreak of the Civil War, when he returned to his home in the North. From 1873 to 1879 he was Professor of practical mechanics at Cornell University. Since 1880 he has been President of the Straight Line Engine Co. He was the third President of the American Society of Mechanical Engineers.

Messrs. Marcheix and Garbe, Civil Engineers of the Corps des Ponts et Chaussées of France, are inspecting important American engineering works. They have recently completed an inspection tour of the New York State Barge Canal and are soon to start for a trip through Canada and the Middle West. Later they will make a tour to the Northwest, including British Columbia and California. They will visit New Orleans and the Panama before returning to France. Messrs. Marcheix and Garbe are temporary members of the Permanent Commission of French Engineers in the United States with headquarters in the Whitehall Building, New York City, of which Mr. Jean de Pulligny is Chief. They will be succeeded on the commission by Messrs. Lehman and Simon, Mining Engineers.

Mr. D. W. Bowman, M. Am. Soc. C. E., Chief Engineer of the Phoenix Iron Co., Phoenixville, Penn., has retired to become Consulting Engineer of the company. Mr. Bowman is a graduate of Cornell University and first became connected with the Phoenixville Iron Works in 1873, when he joined the engineering staff of Charles Reeves & Co., predecessors of the Phoenix Bridge Co. He remained with the company eight years as a detailer and designer, at the time the company was building the Sixth Ave. Elevated railway in New York City, and much other important work. Since that time, with the exception of about seven years spent in engineering work elsewhere, he has been connected with the Phoenix Iron Co. For the past 13 years he has been Chief Engineer. In the future Mr. Bowman will devote his time to consulting work.

Mr. William C. Downing, Superintendent of the Pittsburgh division of the Pennsylvania R.R. lines west of Pittsburgh, has been promoted to be General Superintendent of the Central system of the lines operated by the Pennsylvania Co., succeeding Mr. Thomas B. Hamilton, promoted, as noted elsewhere. Mr. Downing, like his predecessor, is a civil engineer by experience. At 20 years of age he was a rodman on the Eastern division of the Chicago, St. Louis & Pittsburgh R.R. Later he was promoted to be Assistant Engineer and Inspector of Masonry. From 1891 to 1895 he was Engineer of Maintenance-of-Way of the Richmond division. For six years, 1895 to 1901, he was Engineer of Maintenance-of-Way of the Vandalia R.R., at St. Louis, Mo., and at Terre Haute, Ind. In June, 1901, he promoted into the operating department as Superintendent of the Peoria division.

Mr. C. H. Stein, M. Am. Soc. C. E., Engineer of Maintenance-of-Way of the Central R.R. of New Jersey, Jersey City, N. J., has been appointed Superintendent of the New Jersey Central and Lehigh & Susquehanna divisions, succeeding Mr. E. E. Kerwin, resigned. Mr. Stein is a native of Baltimore, Md., and a graduate of Baltimore City College. His engineering experience was begun in 1889 as a rodman on the Western Maryland R.R. Later he was transitman and Assistant Engineer on preliminary surveys and construction. For 10 years, 1893 to 1903, he was Assistant Roadmaster of the Western Maryland R.R., leaving this position to become Assistant Supervisor on the Philadelphia & Reading Ry., at Reading, Penn. From 1895 to 1907 he was Supervisor on the main line, and since 1907 has been Engineer of Maintenance-of-Way of the Central R.R. of New Jersey.

Mr. Thomas Benton Hamilton, recently General Superintendent of the Central system of the Pennsylvania R.R. lines west of Pittsburgh, has been promoted to be General Manager of the Vandalia R.R., at St. Louis, Mo., succeeding Mr. A. M. Schoyer, elected Vice-President of the Pennsylvania R.R. lines west of Pittsburgh, at Chicago, Ill., as noted in our issue of Jan. 16. Mr. Hamilton is one of the many high officials of the Pennsylvania lines whose start in railway work was with the engineering corps. He was born in Columbus, Ohio, in 1865, and graduated from Princeton University in 1888. The following November he secured an opening as rodman with the engineering corps of the Jeffersonville, Madison & Indianapolis Ry., at Louisville, Ky. From 1890 to 1896 he was a member of the engineering staff of the Pittsburgh division of the Pittsburgh, Cincinnati & St. Louis Ry.; in 1896 he was promoted to be Assistant Engineer of the Pittsburgh division. From 1897 to 1901 Mr. Hamilton served successively as Engineer of Maintenance-of-Way of the Toledo division of the Pennsylvania Co., the Cincinnati division of Pittsburgh, Chicago & St. Louis Ry. and of the Cleveland & Pittsburgh division of the Pennsylvania Co. He then left the engineering for the operating department, becoming Superintendent of the Erie & Ashtabula division of the Pennsylvania Co. After serving eight years as Superintendent of the Cleveland & Pittsburgh division he was promoted to be General Superintendent of the Central system of the Pennsylvania Co., Jan. 1, 1912.

OBITUARY

Dewitt Franklin Austin, for a number of years City Engineer of Auburn, N. Y., died recently at the home of his sister in Brooklyn, N. Y. He was 83 years old.

Isaac Stiles Hopkins, founder and first President of the Georgia School of Technology, died Feb. 3, at the age of 74 years. He was a Methodist clergyman and from 1883 to 1887 was President of Emory College. He was President of the Georgia School of Technology from 1888 to 1896.

W. J. Crocken, Civil Engineer and Surveyor, and former City Engineer of East St. Louis, Ill., died Jan. 30, at his home in East St. Louis, aged 57 years. For a number of years he was engaged in location surveys for the Chicago, Burlington & Quincy R.R., the Union Pacific R.R., the Denver & Rio Grande R.R., the Ohio Central R.R. He went to East St. Louis in 1895 as Assistant City Engineer, in which capacity he served until 1904, when he was made City Engineer. He resigned as City Engineer in 1911.

James Gresham, M. Inst. C. E., who had an international fame as an inventor, died Feb. 13, at his home near Manchester, England, aged 77 years. Among his first inventions

were improvements to the domestic sewing machine, spinning machinery and to the Giffard feed-water injector. In 1877 he took out his first patent in connection with continuous railway brakes operating on the vacuum system. Other inventions followed in the same line and Mr. Gresham's name became as well known on English railways as the name of Westinghouse was on American railways. He also invented a steam-operated sanding apparatus for railway locomotives, now generally in use in England. Mr. Gresham was a member of the Institution of Mechanical Engineers and a Past-President of the Manchester Association of Engineers.

F. H. Kindl, Consulting Structural Engineer, of Pittsburgh, Penn., died Feb. 4. He was born in Bohemia, Austria, and came to this country with his parents when a child. He graduated from the Case School of Applied Science in Cleveland, Ohio, in 1884. After a few years' experience in engineering work in Chicago, Ill., he went to Pittsburgh, where he became Structural and Chief Engineer of the Carnegie Steel Co. In this capacity he was one of the pioneers in steel-frame skyscraper construction, the office building of the Carnegie Steel Co., in Pittsburgh being among the first in that city. He afterward specialized in structural work for skyscrapers. He is known to all structural engineers throughout the country as the compiler of the famous "Carnegie Handbook." From 1900 to the time of his death he was a Consulting Engineer on tall-building construction; among the more important buildings with the design of which he was connected were the Frick Building in Pittsburgh, and the Brotherhood of Locomotive Engineers' Building in Cleveland. Mr. Kindl is survived by a widow and three children.

Joseph B. Baker, Superintendent of the Philadelphia Terminal division of the Pennsylvania R.R., died at his home in Merion, Penn., Feb. 3. He was born in Lancaster County, Penn., Aug. 31, 1855. He was educated at private schools and Lehigh University. His railway experience began in 1883 as a rodman in the roadway department of the Philadelphia & Reading Ry. The following year he joined the engineering corps of the Pennsylvania R.R., with which railway and its subsidiaries he had served continuously ever since. He was promoted through the engineering department to be Assistant Supervisor and in 1888 was appointed Assistant Superintendent of the Pittsburgh division. In 1889, however, he returned to the engineering department as Supervisor and was promoted to be Assistant Engineer. Again, in 1897, he returned to the operating department as Assistant Superintendent of the Pittsburgh division, but two years later was once more Assistant Engineer. In 1902 he was promoted to be Superintendent of the Frederick division at York, Penn., and was subsequently promoted to be Superintendent of more important divisions.

ENGINEERING SOCIETIES

COMING MEETINGS

AMERICAN CONCRETE INSTITUTE.
Feb. 16-20. Annual meeting in Chicago, Ill. Secy., E. E. Krauss, Harrison Building, Philadelphia.

IOWA ENGINEERING SOCIETY.
Feb. 18-20. Annual meeting at Council Bluffs, Iowa. Secy., S. M. Woodward, Iowa City, Iowa.

MINNESOTA ENGINEERS' AND SURVEYORS' SOCIETY.
Feb. 24-25. Annual meeting at St. Paul, Minn. President, Wm. Danforth, 411 Hackney Building, St. Paul, Minn.

INDIANA SANITARY AND WATER SUPPLY ASSOCIATION.
Feb. 26-27. Annual meeting at Indianapolis, Ind. Secy., Dr. W. F. King, Indianapolis.

VERMONT SOCIETY OF ENGINEERS.
Mar. 12. Annual meeting at Burlington, Vt. Secy., Geo. A. Reed, Barre, Vt.

HIGHWAY ENGINEERS' ASSOCIATION OF MISSOURI.
Mar. 18-20. Annual meeting at St. Joseph. Secy., Ray L. Gargill, St. Joseph, Mo.

North Dakota Society of Engineers—At the sixth annual convention to be held at Fargo, N. D., Feb. 12-13, the following papers will be presented: "Flat Slab Concrete Construction," Eric Martinson; "Cement from the Manufacturer's Standpoint," G. A. Burch; "Girder Design and Reinforced-Concrete Construction," S. F. Crabbe; "Deep Sewer Work at Minot," J. R. Graham; "Commercial Water Softening," H. G. Lykken; "Pavements," T. R. Atkinson; "Standardization of Highway Grades and Bridges," John Magill. Among the committee reports to be presented are those on "Drainage"; "Irrigation and Rivers"; "Concrete"; "Municipal Improvements"; "Roads," and "Surveyors' Field Methods." There will be several inspection trips and a number of social features. The Secretary is E. F. Chandler, University, N. D.

Engineers Club of Trenton—This club was organized on Jan. 29, with 102 members. All engineers, engineering architects, metallurgists and chemists are eligible for membership. The by-laws provide for four classes of members: corporate; associate member, associate, and honorary. The following officers were elected: President, Col. Edward A. Stevens, Road Commissioner of New Jersey; 1st Vice-President, Alfred C. Gregory, City Engineer of Sewers and Water; 2d Vice-President, N. A. K. Bugbee, of the N. A. K. Bugbee Engineering Co.; Treasurer, John E. Elliott, Chief Engineer of the local plant of the American Bridge Co., and Secretary, Joseph E. English, Assistant City Engineer of Streets.

American Institute of Electrical Engineers—The second annual midwinter convention will be held in New York City, Feb. 25-27. The convention will be under the direction of the Electric Power Committee. There will be seven sessions as follows: opening session, general matters; power-station session; transmission session; distribution session, etc. On Feb. 25, a dinner and dance will be held at the Hotel Biltmore, under the auspices of the A. I. E. E. Committee on Organization of the 1915 International Electrical Congress. At 8:30 p.m., on Feb. 26, a meeting will be held in the auditorium of the Engineering Societies' Building, under the auspices of the Executive Committee of the above Committee on Organization, and the following will speak: Dr. C. P. Steinmetz; Dr. Wm. Rader; W. D'A. Ryan; James A. Cruikshank, and P. M. Lincoln.

International Congress of Social Insurance—At its meeting on Jan. 31, the Committee on Organization completed arrangements for the Congress to be held in Washington, D. C., in October, 1915, by electing the general officers. The Chairman elected was Hon. Franklin McVeagh; the Secretary, Miles M. Dawson, consulting actuary, New York. The Congress was established as a result of legislation in various nations providing insurance of workmen against incapacity due to industrial accidents and diseases. It is primarily an official body, composed of (but not restricted to) delegates of the several governments.

Idaho Society of Engineers—At the fifth annual convention, held Feb. 5-7, in Boise, the following topics were considered: "Drainage Problems and Methods," J. L. Buckholder; "Economic Use of Water in Relation to Plant Growth," Don Bark; "How to Raise the Efficiency of Irrigation Farmers," J. H. Lowell; "Losses in Canals," P. M. Fogg. The annual banquet was held on Feb. 5. The Secretary is Ira F. Shaffner, of Boise.

Washington Irrigation Institute—At the first annual meeting, held at North Yakima, Wash., Jan. 14-16, certain resolutions were adopted. Coöperation was asked between the state and the nation for reclamation. A minimum charge was recommended for a minimum quantity of water, and a graduated charge for those whose demand exceeds this minimum amount. It was resolved that the next legislature be requested to make an appropriation for investigation in irrigation agriculture. The bill prepared by the Washington Water Code Commission and presented to the 15th legislature of Washington was endorsed as "comprehensive, desirable and necessary." Among the topics discussed were the following: "Experience with Wood-Stave, Concrete and Steel Pipe"; "Canal Lining"; "Measuring Devices"; "Maintenance of Earthwork, Etc."; "Shortening the Irrigation Season"; "Need for an Irrigation Code." The Secretary is R. H. Warnick, North Yakima, Wash.

Engineers' Society of Northeastern Pennsylvania—This organization, formerly known as the Scranton Engineers' Society, held its 17th annual banquet in the Hotel Jermyn, Scranton, Penn., Feb. 5. About 325 persons were present. The society has recently purchased a new club house at an expense of $25,000 and fitted it up at a cost of $5000. It has now 409 members.

After the banquet the meeting was addressed by H. M. Warren, the retiring president. N. P. Lewis, Chief Engineer, Board of Estimate and Apportionment, New York City, spoke on city planning. He said that cities should be planned by engineers before expensive improvements were made. He advocated laws which would create boards having the power to prevent cities and other political units from borrowing money on bonds, the final retiring of which would postdate the life of the utility created. Hudson Maxim spoke on "The Truth About Our Peace and War Problems." Other speakers were E. A. Jones, of the Pennsylvania Highway Department, and H. C. Reynolds, who discussed "The Engineer As An Expert Witness" and advocated that experts be appointed and paid by the court. The Secretary is H. S. Webb, Scranton, Penn.

Engineering Literature

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CORRESPONDENCE

More about Title-Page Dates

Sir—Your editorial on Title Page Dates in your issue of Dec. 18, 1913, and the communication of Wm. H. Wiley, president of John Wiley & Sons, Inc., in your issue of Jan. 15, 1914, lead us to send you the following brief statement of our own policy in this matter:

(1) A reprint or a corrected reprint is not a new edition but a new impression.

(2) The title-page date should remain unchanged, as a reliable and easily located date of the contents, until the book is thoroughly revised.

(3) There is no warrant for changing the title-page date when a book is reprinted without material revision, and requiring the purchaser to seek the truth on the copyright page.

We believe that the title-page date is highly important and because of its importance we think it should be absolutely accurate. The title-page date is the most conspicuous and easily located. Neither the copyright date nor the date of the preface, to which an experienced book buyer may go, serves the purpose of ascertaining the date of the information as conveniently as the title page. Our experience convinces us that a great majority of book buyers look to the title page, not the copyright page, for the date.

MARTIN M. FOSS,
Secretary McGraw-Hill Book Co., Inc.

New York City, Jan. 31, 1914.

From the Author of "The Catskill Water Supply"

Sir—I am writing this to call your attention to a grave injustice done me in your issue of Dec. 18, 1913. Here my "Catskill Water Supply of New York City" is reviewed in what appears to me to be a very superficial and captious spirit. Moreover palpable and evident misstatements are therein made.

The book has now been out about six months, during which time it has been reviewed by many technical and non-technical papers and I have received letters from many well qualified engineers, but none of them say as you do that I have "failed to make the book either a history or readable, in the ordinary meaning of those terms."

You further state that "instead of selecting and describing parts of the work which are typical of the design and construction as a whole he [the author] has taken each section or contract separately and described the work of that section in detail." The author seriously considered adopting the course suggested but that was found to be impractical and undesirable because of the variety and magnitude of the work. For instance, there are about 50 miles of tunnels in many kinds of rock and at all depths from 50 to 1100 ft. These were constructed by many capable contractors using different methods, each perhaps adapted to its location. How then to generalize? I know of no way. All data and information were available in the form given. Again, each contract is a separate problem as a whole. Years ago "Engineering News" published a very instructive book on the Chicago "Main Drainage Canal," in which the geographical method of describing the work was adopted. This book, in my opinion, owes much of its value to the detailed description of the machinery and methods used by the contractors on that great work.

A little study of my book would have shown that typical contracts were selected and described in considerable detail, and that the others were described in much more general terms with particular reference to features which differed from the typical contracts. For instance, Contract 11 (a typical cut-and-cover contract) has 51 pages devoted to it. The contract prices and quantities are given in detail and the development and growth of the work traced. For Contract 25, a similar contract, but of about half the length, only seven pages are given. Under Contract 12 (a typical pressure tunnel contract) 75 pages are given. Under Contract 20, a pressure tunnel of the same length, only seven pages. It is evident that the statement that I have taken each contract separately and in detail is erroneous.

But the most misleading and positively wrong statement is that made in the following sentence:

> This not only tends to much duplication of essentially the same kind of engineering data but makes it next to impossible to use the book as reference to the ways and means of the construction of any general or particular detail, unless its geographical location happens to be known.

The reviewer in his haste evidently overlooked the index at the back of the book, which was very carefully prepared to make easy the use of the book as a reference. No geographical knowledge whatever is necessary to use the index. For instance, any one interested in the use of steel forms will find the following reference:

Steel Forms

Cut-and-cover aqueduct	212,218, etc.
Grade tunnel	329,344, etc.
Pressure cut-and-cover aqueduct	307,314, etc.
Pressure tunnel	307,314, etc.
Shaft	316,344, etc.
Steel pipe	458,468, etc.
Walls	151,459, etc.

Again, anybody referring to the table of contents at the front of the book can readily ascertain the subjects treated and their pages. The list of illustrations and tables, and the mere turning over of the pages will about indicate the contents. Again, sub-headings in heavy type are freely used, so that "he who runs may read."

The geographical subdivision can be readily learned from the map and still easier from the profile which was specially prepared for the purpose. A glance at this shows the location of each contract and the kind of aqueduct constructed under each.

I am pleased at the last sentence, which states: "It will undoubtedly be of great service to engineers engaged in similar work who can take the time to dig out and digest the data suited to their needs, as well as to writers of engineering textbooks," but I believe that the information in the book is readily reached and does not have to be dug out. The author discarded an immense number of data and took great pains to present those given in a readable and available form.

In assuming the arduous task of describing the immense work of the "Catskill Water Supply," the author was supported by the desire to do justice to it in all its parts and to render a service to the engineering profession by making its lessons and data available. He sought not only to present the most successful methods of construction, but also the less successful and even the failures, in order that the profession might know not only "what" was constructed, but "how" and "why."

New York City, Jan. 9, 1914. LAZARUS WHITE.

REVIEWS AND NOTES

A Mathematical Text on Some Phases of Bridge Design

Reviewed by LEWIS E. MOORE*

SUSPENSION BRIDGES, ARCH RIBS AND CANTILEVERS—By Wm. H. Burr, M. Am. Soc. C. E., Professor of Civil Engineering, Columbia University. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. xi + 417; illustrated. $4.50, net.

The volume under review was written, according to the author's prefatory statement, to meet his classroom needs, which are a "clear elucidation of general principles in connection with their bearing upon engineering work." In connection with this it may be said that it is very difficult to satisfactorily give an undergraduate student real knowledge of statically indeterminate structures, such as suspension bridges.

The first chapter takes up the approximate theories of the stiffened suspension bridge, making throughout such assumptions as may be necessary in order to treat each part as though it were statically determined. The author states that these methods are sufficiently close for approximate computations and preliminary estimates, but that more accurate methods should be used for final designs. Two methods of loading are used: a uniform load extending from one end of the span and a single concentrated load placed anywhere. The parabolic form of the cable curve is deduced, together with the formulas for the resultant tension in the cable and length of cable. Suspension rods, both vertical and inclined, and anchorages are followed by the theory of stiffening trusses with ends both free and anchored. The chapter closes with a brief paragraph stating the extent of error involved in the assumptions made.

The next chapter treats of the stiffening truss with center hinge and gives the maximum shears and moments which are encountered under various assumptions as to load. The uniform loads are assumed to extend a variable distance from the end and center hinges. The author fails to point out that the maximum moment for uniform load is obtained with the load covering the middle portion of one truss. The chapter closes with the moments and shears caused by a single concentrated load.

The third chapter takes up the general conditions of equilibrium for perfectly flexible cables or frames under vertical loads, giving the general equation for the curve of the cable under any kind of loading and developing the equation of the parabolic and catenary forms of cable curves. The stresses in the cable from dead load and from weight of cable follow. A table, together with its derivation, giving the approximate greatest possible spans for various cable stress intensities and ratios of sag to span, follows. An equation giving the economical ratio of sag to span is next derived. The deflection of the cable for certain loadings, the center deflection due to a change of cable length, and that due to saddle displacement are also given. Unsymmetrical deflections and secondary stresses close the chapter.

The statically indeterminate stiffening truss is next considered, basing the treatment upon the elastic deformation of the structure. The theory of this chapter assumes that the cable curve does not change its form, and hence, as the author states, is not strictly accurate, although nearly so. The determination of the stress in the cable for these assumptions follows, together with the effect on the cable of the shear in the truss. A tabulated statement of the expressions for finding the various quantities entering into a solution by this method is given, together with their derivation. The treatment is extended to cover various cases of stiffening trusses, the finding of points of contraflexure and of deflections. Several tables of numerical values of certain quantities involved in the solution of the formulas are given. Influence lines for moments and shears and for deflections are given. These methods are then applied to certain typical members in the Manhattan Bridge and influence lines for moments and shears are drawn for certain cases. The chapter closes with the finding of expressions for maximum bending moments, reactions and end shears.

The fifth chapter treats the straight stiffening truss by a theory based on the method of deflections, or rather of work. The dead load is assumed to cause no stress in the stiffening truss. "The plan of treatment is first to find a general expression for the moving load deflections corresponding to the actual bending moments in the stiffening truss. The combined deflection of cable and stretch of suspenders at any point must be equal to the stiffening truss deflection at the same point. The fact that the dead load performs no work during any deflection is brought out. The fundamental equations are derived together with values for the constants of integration. Thermal changes in the cables and other portions are treated and formulas derived. These methods are then applied to the Manhattan Bridge.

In the next chapter the effect of temperature changes on different parts of the structure is discussed and formulas for finding temperature stresses are derived. The arch rib, which may be considered as an inverted suspension bridge, is next treated. The general case of an arch rib with fixed ends comes first, and the formulas are applied to a reinforced-concrete arch rib. A combination of analytical and graphical methods is used, involving the drawing and correction of a trial polygon. Ribs with hinged ends follow, including the application of these methods to artificial loads. Thermal stresses, crown deflections, and the effect of shortening of the arch rib follow.

The general analytic theory of elastic arch ribs according to the law of least work, is next presented, and formulas for the different quantities for the different end conditions are derived. The finding of intensity of stress on cross-sections and the application to reinforcedconcrete ribs are given. Then follow position lines for finding reactions, and a method for finding the position and amount of loading required to give greatest bending moment.

Three-hinged arches and the spandrel-braced arch are given a chapter each. Finally the author takes up the analytical methods of treating cantilevers. The economic lengths of spans and arms is given, together with the elements determining the width between centers of cantilever trusses. Formulas are deduced for the cantilever without suspended span, and are then applied to the Queensboro Bridge.

Of the two appendixes the first takes up limiting spans and depths of stiffening trusses and the second gives various formulas for reinforced concrete.

The book is devoted almost wholly to the mathematics of the various subjects treated and deals with actual cases in two or three illustrative examples only. The only questions of design touched upon have to do with broad general economic features, such as the ratio of sag to span, economic depths of stiffening trusses, and the like. Details are not touched upon. Although the title is "Suspension Bridges," other structures are discussed, as has been mentioned. The treatment as a whole is comprehensive and clear, although the inherent difficulties of the subject are such that the student cannot hope to master it in one reading. There may be differences of opinion among teachers as to the advisability of attempting to teach to students a subject which so few practising engineers are ever called upon to use, but the book is one which many engineers will want upon their shelves, including as it does arches and cantilevers, as well as suspension bridges.

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LETTERS AND RECOLLECTIONS OF ALEXANDER AGASSIZ, With a Sketch of His Life and Work—Edited by G. R. Agassiz. Boston and New York: Houghton, Mifflin Co. Cloth; 6x9 in.; pp. 454; numerous plates and other illustrations. $3.50, net.

By a skillful interweaving of letters and narrative the son of Alexander Agassiz has presented an interesting sketch of the life of this great American naturalist and remarkably successful mining engineer-superintendent and financier.

Born in Neuchatel, Switzerland, in 1835, Alexander Agassiz came to the United States in 1849. In 1855 he graduated from Harvard, where his father, Louis Agassiz, was professor of natural history. Entering immediately the engineering department of the Lawrence Scientific School, Alexander graduated there with high honors in 1857. After devoting two years to the study of chemistry and to teaching, he spent the summer of 1859 on the U. S. Coast and Geodetic Survey, surveying the boundary line between the United States and British Columbia, in the Bay of Georgia. The weather being unsuitable for much surveying, the young engineer began the studies of marine life which afterwards made him famous.

Without attempting to follow the life of Agassiz in detail it may be said that shortly after the surveying trip, Agassiz was for a time superintendent of what subsequently became the famous Calumet and Hecla Copper Mines, in Michigan. He continued to take an active part in the management of this property all his life and from it derived the vast sums which he devoted to the great university museum founded by his father at Harvard, as well as large amounts

spent in his numerous expeditions for deep-sea and coral-reef studies in all parts of the world.

Throughout his career, whether engaged in mining, deep-sea dredging, the management of the Harvard museum or the classification and description of the life of the ocean, Agassiz showed great powers of concentration, skillful planning and ultimate achievement. His engineering training, or perhaps more truly his engineering genius, stood him in good stead throughout his life, and unquestionably contributed largely to his success in ways not often recognized by any except his closest acquaintances. But to Agassiz, engineering, like mining and finance, was only a tool—most useful and appreciated—with which to produce funds to build and equip the Harvard museum and to make possible his costly scientific expeditions and memoirs. Taking all this into account, the author and editor of these recollections and letters is justified in not presenting so much about the mining activities of his father as engineers would have liked to see in this interesting memorial of one of America's greatest adopted sons.

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The Valuation of Public Utilities

Reviewed by LEONARD METCALF*

PUBLIC UTILITIES, THEIR COST NEW AND DEPRECIATION—By Hammond V. Hayes, Consulting Engineer. New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. xii + 262. $2, net.

Mr. Hayes has written an admirable book upon the principles which should govern the valuation of public utility properties. While written in an easy style, the book is clear in conception and presentation, and gives evidence of thoughtful study and careful review of court decisions and commission rulings in such cases.

In successive chapters the author has taken up general considerations governing property valuation, replacements, costs of physical property, determination of replacement costs, value as going concern, value of good will and franchises, original cost, commercial value, worth of the service to the consumer, reserves for depreciation, life of plant, depreciation, fair present value as a basis for rating and for condemnation or sale, and general considerations relative to the regulation of public utility undertakings.

The treatment of the finding of replacement cost is clear and adequate; that of going value or development expense, and the applicability of the different methods of its determination, one of the best which has yet appeared in print.

The discussion relating to depreciation, reserves for renewals, etc., is admirable. It is to be regretted, however, that the author did not discuss, or at least call more pointed attention to, the differences in the length of life of plant of public utilities of different kinds and its effect upon depreciation reserves—for the illustrations chosen relate more particularly to such public utilities as telephone companies, the plants of which are of much shorter life than those of waterworks, for instance. The discussion relating to the choice of the method of determining depreciation reserves or accrued depreciation is not only sound but refreshing, recognizing as it does clearly that, where depreciation reserves have been determined by sinking-fund methods, it is unfair to apply straight-line methods, and vice versa.

The author leans strongly to the investment-cost basis of valuation as likely to prove the most satisfactory one in practical operation under future conditions and public-service commission control. On the other hand, he recognizes clearly that under existing laws, the fair value of the property must be found.

His discussion of the treatment of unearned increments is interesting and shows clearly the conflicting character of court and commission decisions. He draws a sharp distinction between the basis of action of state commissions, which must take into consideration a fair rate of return in the light of the hazard involved, and of the courts, which have to determine the limits of confiscation rather than of fair rate of return. In a discussion upon the tendency of later decisions to establish a fair cost new, he gives an excellent statement of the present trend of thought and evident inclination of commissions on the one hand, to give weight to present value as well as investment cost, and on the other hand of courts to take into consideration not only fair present value but the conditions involved in the building up of the plant and property of the corporation. He concludes that while the state authorities have hitherto inclined strongly to investment cost and the courts to fair value in appraisal, there is an evident tendency to approach a common ground.

The disadvantage of public utility control, where it fails to give due credit to superior management, is well discussed by the author, and the need of appointing to public-service commissions men of the highest type is clearly brought out.

While the reader may be inclined to question individual paragraphs or statements contained in the book, its complete perusal will be certain to leave the impression of its essential fairness and of the desire of the author to do full justice, not only to the corporation, but to the public.

The book will prove a valuable addition to the library of managers of public utilities, engineers, accountants and students of this important subject.

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Electrical Engineering

Reviewed by F. C. CALDWELL*

ELECTRICAL ENGINEERING; The Theory and Characteristics of Electrical Circuits and Machinery—By Clarence V. Christie, Assistant Professor of Electrical Engineering, McGill University, Montreal, Can. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xii + 417; 378 text illustrations. $4, net.

To cover the field of electrical engineering in a little over four hundred pages is a somewhat Herculean task. It is interesting to see how well Prof. Christie has succeeded in accomplishing this. He has indeed not undertaken quite all that his main title would indicate, but has confined himself, as indicated in the subtitle, to a consideration of electrostatics, magnetism and electromagnetics, direct- and alternating-current circuits and machinery, storage batteries and transmission. It is surprising how much information concerning batteries is given in the page and half devoted to this subject, and the fifteen pages of the chapter on the transmission line are equally remarkable for the fund of information which they contain concerning the reactance, capacity, regulation and other characteristics of a transmission circuit. It is, however, debatable whether it would not have been better to omit these subjects altogether rather than to treat them so very briefly. However, brevity combined with unusual clearness of statement is the most striking characteristic of the whole book.

Following, as it would seem, the time-honored practice of books on the physics of electricity, the first forty pages are devoted to a very satisfactory discussion of capacity and electrostatic phenomena as met with in condensers and transmission lines. The only criticism to be made of this is that neither its importance nor its simplicity would seem to justify its location as the first chapter of a treatise on electrical engineering. The treatment of magnetism and magnets is very complete on the theoretical side, though it might have suited engineers better had the magnetic circuit been emphasized more and the magnetic poles less. Again, many will regret the use of the inch instead of the centimeter measure in the magnetization curves.

The emphasis on conductance, especially as applied to parallel direct-current circuits, is to be commended; also the use of the circular mil foot for resistivity and a table giving the same for different temperatures. On the other hand, one could wish that the specifications of the Society for Testing Materials had been followed and fewer decimals used in the diameters of wires in the wire table. A long mathematical discussion of the efficiency of the potentiometer seems of questionable utility. The treatment of inductance and capacity is full and very good, as indeed is the whole discussion of the phenomena of alternating circuits. Numerous well chosen examples are given. Here, as all through the book, the Steinmetz symbolic method, or, as it is called by the author, the method of rectangular coördinates, is effectively used along with the usual graphical solutions. This is one of the strong points of the book.

The treatment of direct-current machinery is remarkably inclusive, considering that it occupies only ninety pages of text and illustrations. Armature windings are well covered, with several pages of diagrams. The derivation of the external from the total characteristics of generators is one of the subjects which is slighted. There are also a number of points connected with the operation of motors which one would wish more fully treated. The subjects of commutation and of losses are well discussed. Here, as all through the book, the entire absence of illustrations of actual apparatus is noticeable.

About 170 pages are given to alternating-current apparatus, all the important forms of which are touched upon and generally well covered as to their most important characteristics. As with the direct-current machines, much attention is given to the windings of alternator armatures. The difficulties involved in the accurate determination of the regulation of alternators from light load tests are perhaps

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not sufficiently impressed upon the student. The treatment of the synchronous motor is very brief and one misses the beautiful graphical treatments which lend themselves to this subject.

The theoretical treatment of the transformer is full and one notes especially the application of the symbolic method to the solution of transformer diagrams. Both the polyphase and single-phase induction motors are well treated, the discussion of the circle diagram being particularly full and satisfactory. Commutator alternating-current motors are very briefly but clearly described. Converters receive considerable attention, the mathematical discussion of heating and current capacity being particularly notable.

As the work is announced especially as a foundation for lecture courses for junior and senior students in electrical engineering, its adaptability to this purpose will be of special interest to teachers. It certainly would require much supplementing by lectures to satisfactorily cover the subjects treated, and the question that would present itself to the teacher would be, whether the best results could be obtained, on the one hand, by using this brief but excellent discussion of the theoretical side of the subject as a text, and covering all the remainder, including most of the descriptive part, by lectures, or, on the other hand, by seeking several texts which together would more nearly cover the whole field, and thus reduce the amount of lecturing necessary. While in many cases the latter course would be preferable, the use of the book would seem particularly adapted to the briefer courses in dynamo machinery sometimes given under the direction of departments of physics. The book is also well suited to the needs of the man of mathematical inclination who wishes to inform himself rapidly upon the theoretical aspects of the subject, but who is not so much interested in practical details.

Mechanical Refrigeration

Reviewed by FRED OPHULS*

MECHANICAL REFRIGERATION: A Treatise for Technical Students and Engineers—By H. J. Macintire, M. Am. Soc. M. E., Assistant Professor of Mechanical Engineering, University of Washington. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. ix + 346; 121 text figures. $4, net.

The subject of Mr. Macintire's book is of special interest to mechanical engineers and students at this time because of the growth of cold-storage, ice-making and other business directly dependent on ready attainment of low temperature, and because of the many new applications of mechanical refrigeration to manufacturing processes. The field is good for a reliable uptodate treatise on mechanical refrigeration, on account of the many improvements that have been made during the last few years in the equipment of refrigerating and ice-making plants.

The first casual examination of the volume seemed to indicate that it might be such a desirable book. There were to be seen a short general review of theory, sections on ammonia and carbon-dioxide compression systems, on standard absorption apparatus and on dense-air and water-vapor equipment. There was a long section devoted to the varied auxiliaries which practice has brought into use; further along there was a comparison of wet and dry gas compression, and of various refrigerating media. Some considerable space was seen to be given up to further details of special subdivisions like testing of machines, heat insulation, ice making, cold storage, air cooling, and a long list of industrial applications—treatment of milk, ice-cream, beer, fruit for shipment, quicksand excavation, etc. The book was found to be plentifully interspersed with diagrams, great and small, and various tables.

Thus encouraged a careful examination of the text was made to determine how satisfactorily the various topics named had been treated. The reviewer found that the book contains some valuable tables and diagrams, but that it lacks that peculiar combination of theoretical and practical information which is necessary to make its contents of real value to engineers and laymen interested in this class of machinery.

First, overlooking what are no doubt typographical errors, or errors due to insufficient proof-reading, there are a number of incorrect statements in the text and a few mistakes in the interpretation of formulas copied from other writers.

As an example of the former, the first paragraph on page 32 may be quoted. The author comparing the speed of the suction and discharge vapors when passing through the valves of the compressor, says: "Even with the same size discharge valve [same size as suction valve] the velocity of discharge is much greater than that given above [a table is given showing the average speed of the suction vapor for the different sizes of suction openings] since it has but one-third or one-fourth of the relative time for discharge." The fact is that for this condition the average velocity of discharge vapor is less than that of the suction vapor. The author forgets that, while the same weight of ammonia is discharged as is drawn into the compressor, the discharge vapor is at a higher pressure than the suction vapor, and that the average speed of the piston for the last one-third or one-fourth of the stroke is less than for the whole stroke.

Between pages 170 and 171 is inserted Fig. 62, which is intended to show the effect of the thickness of ice frozen and the temperature of the brine on the time of freezing. The two formulas used for obtaining the curves in this figure were copied from an article given in "Ice and Refrigeration" some months ago. Careful reading of that article will show that the temperature "t" given therein is meant to represent the temperature of the freezing surface and not the temperature of the brine in the can ice-making tank, or the temperature of the ammonia in a direct-expansion freezing plate of a plate ice-making tank. Now can ice 11 in. thick or 5½ in. from each freezing surface can be frozen with 12° brine in 48 hours, if the water is put into the cans at about 38° F. Fig. 62, however, leads one to believe that this thickness of can ice will be frozen in 48 hours with brine over 18° F. which, of course, is impossible. The author seems to forget that the temperature of the freezing surface of a can is always higher than the average temperature of the brine in the freezing tank, as recorded by a thermometer placed near the agitators.

The test data given in the book are useless in practical applications and sometimes misleading on account of the special conditions under which the tests were made. For instance, a test of an absorption refrigerating machine is quoted where made with 43° cooling water, which is not available in summer in the temperate zone.

In the discussion on the effect of the heating of the suction gas by the internal surface of the compressor, it is held that the suction gas at the end of the suction stroke is heated only 7.1° F., whereas with real volumetric efficiencies of from 70 to 80%, the temperature of the suction gas at the end of the suction stroke must be nearly 100° higher than the temperature of the vapor in the suction pipe. The error in these calculations arises from assuming that the average temperature of the cylinder walls determines the amount of superheating of the vapor in the cylinder, whereas authorities on this subject have found that the superheating effect seems to be due to the heat which is lodged during the compression stroke in an extremely thin layer of the cylinder metal directly exposed to the maximum compression temperature. The temperature of part of this surface may easily be higher than the temperature of the vapor in the discharge pipe of the compressor.

For such reasons, it is advisable that only such men use this book as are able to separate the correct from the incorrect statements and the good data from the poor given therein. It is to be hoped that, when a second edition is printed, the numerous typographical and other errors will be eliminated from the text and that the expurgated edition will contain more information of practical value.

From the foregoing it is seen why the reviewer does not approve of the book for use in training students or as a reference book for engineers. Apparently, a great deal of information was simply obtained from manufacturers; in several places arguments used by salesmen are advanced here as actual facts or judicial statements. This should not be the case in a book of this kind. The typographical errors are so many, that the book must have been gotten out in an extreme hurry.

Applications of Compressed Air

COMPRESSED AIR PRACTICE—By Frank Richards. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. ix + 325; 96 illustrations. $3, net.

The author of this book has long been known as one of the most prolific writers upon what may be called compressed air engineering. In his preface (which has the unique title "Before Beginning") the author recalls that his little book entitled "Compressed Air" was written twenty years ago. Some small portion of this early work, he says, may be recognized in the present volume; but we surmise it would take close examination to discover the likeness between the two volumes, the progress in two decades has been so great and so much of the present book is taken up with descriptions of recent applications of compressed air.

The scope and method of treatment of the book are quite different from that of the ordinary technical treatise. Some

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idea of the subjects covered may be gathered from the following list of titles of some of the principal chapters: The Compressed Air Problem; Tables and Diagrams for Computations in Air Compression; Single-Stage Compression; Two-Stage and Three-Stage Compression; Air Compressor Regulating Devices; The Turbo-Compressor; The Taylor Compressor; The Humphrey Pump; Power Cost of Compressed Air; Reheating Compressed Air; Pipe Transmission; Compressor and Receiver Fires and Explosions; Side Lines for the Air Compressor; Obtaining Gasoline by Compression; the Electric Air Drill; The Air Lift; Air for Large Steam Hammers; The Cement Gun.

Those who are in search of details of air compressor machinery design will find very little on the subject in this book. Like most American technical books on mechanical engineering subjects, the work is also deficient in its presentation of mechanical drawings showing clearly the constructions described. In the chapter on Air Compressor Regulating Devices, for instance, the only illustrations are a halftone view illustrating the clearance controller, and a set of indicator cards illustrating its action.

It is difficult to see what the chapter on obtaining gasoline by compression of natural gas has to do with compressed air practice except that compressors are used in the work, as they are also, for example, in refrigerating machinery which is not mentioned. The chapter on "Side Lines for the Air Compressor" is devoted to setting forth the author's scheme for high-pressure distribution of illuminating gas in cities in place of the low-pressure distribution from gasholders now practically universal. The Humphrey pump description is another case where the author appears to have wandered away from his subject. It is to be said also that in many of the chapters the author contents himself with a semi-popular treatment of the subject; and the engineer in search of detail drawings and definite figures will be more or less disappointed.

On the other hand, in other chapters, such as those on Generating Power from Compressed Air, Tables and Diagrams for Air Compressor Computations, and Transmission of Compressed Air in Pipes, there are extended tables and diagrams, which are extremely useful for reference.

We believe the author would have done well to have followed the example of numerous recent writers and given liberal credit to the sources of his information, and also something of the history of the art he describes. For example, in the chapter on the air lift it would have been entirely appropriate to have given a paragraph or two at least to the history of its development in this country with credit to those who were chiefly responsible for such development.

Granted that most of us are too busy making engineering history to stop to write it, it does seem that in a book of this sort, which treats in a semi-popular way the various applications of compressed air, it would have added to the interest of the book to give some word concerning the engineers most prominent in the various developments. This is all the more the case since there are comparatively few now living who could perform this task for the compressed air industry better than could the author. We hope his book will pass through editions enough so that this lack may be to some extent supplied.

The Revival of "Natural Philosophy"

PRACTICAL PHYSICS FOR SECONDARY SCHOOLS: Fundamental Principles and Applications to Daily Life—By N. Henry Black, Science Master, Roxbury Latin School, Boston, Mass., and Harvey N. Davis, Assistant Professor of Physics, Harvard University. New York: The Macmillan Co. Cloth; 5x8 in.; pp. ix + 487; 465 text illustrations and several plates. $1.25.

MECHANICS AND HEAT: An Elementary Course of Applied Physics—By J. Duncan, M. I. Mech. E., Head of Department of Civil and Mechanical Engineering, Municipal Technical Institute, West Ham; author of "Applied Mechanics for Beginners" and "Steam and Other Engines." New York: The Macmillan Co. London: Macmillan and Co., Ltd. Cloth; 5x8 in.; pp. xiii + 381; 314 text illustrations. $1, net.

There has been a growing demand in the last five years or more for a reformation in teaching elementary physics. The critics have shown that common-school pupils are not generally grasping the true orderliness of natural phenomena and their importance in common human activities. Nor have these pupils, 90% of whom will never receive any further formal instruction in science, carried with them an ability, which is very useful in all walks of life, for original experiment and observation to derive some statement of a truth not previously comprehended. Complaint has been free that students coming to our technical schools are unduly handicapped by not having acquired just this sort of mental method which is so essential for success in engineering.

The trouble with elementary physics teaching has come from school work which has grown more and more abstract—as though it was undignified to bring into the classroom the thousand homely objects of daily contact. Many of the difficulties exist because the teachers have used deductive methods—have given general laws and followed them by particular facts and hypothetical experiments. The pupils' experimentation has been mere verification. In short, the cart has been put before the horse and natural incentive to development of judgment has been killed off.

All this tells what the Black & Davis book is not. The book also appeals to us by its more positive virtues as the best elementary text that has come to our attention. It illuminates the subject by its application to every-day experiences. Concrete facts are stated and experiments are described before there is any attempt to explain and generalize. The more difficult concepts are led up to by careful steps which can be followed as the pupil gains in experience and knowledge. At the end of each chapter the important generalized statements are briefly summarized. There are scores of questions propounded which a pupil cannot answer without some sort of original investigation. The numerous problems involve actualities throughout and in each case there should be no difficulty in forming a mental picture of the situation behind each problem. Particular attention should be called to the skillful way in which Newton's laws of motion are derived, and in which energy and momentum concepts are employed in helping a student answer questions about the actions of trains, steamboats, etc.

The authors first take up weights and measures, simple machines and mechanics of liquids and gases. Then some of the more hidden matters, like the equilibrium of forces, the stress-strain, force-acceleration and force-distance (work) relations are approached. With such preparation in mechanics, the pupils are taken aside into heat, magnetism and electricity, sound, light and finally into electric waves (wireless telegraphy, cathode and Roentgen rays, and radioactivity). Throughout these special fields, energy relations of phenomena have been discussed quite as much as possible and with great advantage.

The evils of the great majority of older texts have been fully disclosed by such attacks as C. R. Mann's "Teaching of Physics" (see "Engineering News," Sept 12, 1913.) Black & Davis' work shows about all the desirable characteristics which Mann and others have demanded of new texts. It must not be supposed, however, that this book can make a poor teacher into a good one. Moreover, this text does not directly present the experiments which pupils themselves should perform and just as good judgment as ever is required in directing laboratory work to cultivate inductive-working minds.

The British text shows a few remote resemblances to the American by its partial breaking away from pure deductive method and by its greater utilization of more common objects and quantities. But the author does not show a consistent and studied effort to make his experiments, to state his facts and then to draw his conclusions, for he drops back to propounding a law and then verifying it. Sometimes he mixes methods, giving (as in his fourth chapter where the principles of moments and couples in equilibrium are developed) definitions, hypothetical experiments, partial explanations, practical experiments and then final generalization into a law. In the problems, familiar objects and real dimensions figure largely, though frequently the author drops back to "a uniform bar A. B.," "a bent lever A. B. C.," "a triangular plate A. B. C.,' "material of specific gravity = 3," etc.

The presentation is more brusque, or less "dilute," in appearance than the American book and this is explained probably because of the more mature and selected students who will use it. The author starts off with descriptions of measuring instruments and definitions of matter, force, density, etc.; he then works in order through combined forces, moments, couples, stress and strain, beam action, work and power, friction, simple machines, velocity, acceleration, inertia, momentum, and the mechanics of liquids, this last completing his first division, and about half the book. It is interesting to note that the author has avoided a discussion of the law of "action and reaction"; also he speaks frequently of a "force acting on a body" as though it was some vague intangible tug not requiring the presence of a second body.

In the second division, on "Heat," there is first a section on thermometry and then one on calorimetry. These are followed by a presentation of the properties of gases and vapors. There is a chapter on fuels, several on steam engines and boilers, and finally one on internal-combustion motors;

these three subjects are treated much more in detail than would ordinarily be expected for a book on physics and suggests some special purpose in view—perhaps preparation for certain civil-service examinations mentioned in the preface.

Transformers

Reviewed by ARTHUR E. POPE*

TRANSFORMER PRACTICE; Manufacture, Assembling, Connections, Operation and Testing—By William T. Taylor, Fellow, Am. Inst. E. E. Second edition, entirely rewritten, enlarged and reset. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. vii+278; 191 text figures. $2.50, net.

Mr. Taylor deals in a comprehensive way with the entire subject of transformers, covering the main points of original design and construction, and going particularly into detail as regards the numerous possibilities of their connection for service.

That portion of his "Introduction," which treats of the selection of transformers, takes up in a clear and definite manner the various features which should be considered at the time of purchase. The proper proportioning of the losses, with its resultant effect upon operating efficiency, is discussed in a way which duly emphasizes the commercial importance of the subject.

The relative advantages of the different "Delta" and "Y" combinations are dwelt upon to some extent. While the different arguments are well brought out, yet the conclusions reached are somewhat indefinite and in some cases seemingly contradictory. The apparent selection of the Delta-Y to Y-Delta connection as the best all-round operating system is open to some question, particularly on the present-day high-voltage lines, and, in fact, upon all lines where continuity of service is dependent upon a single circuit.

Several chapters are devoted to single-phase, two-phase and three-phase operation. In these sections a great many uncommon connections are discussed in a way which furnishes valuable information for use in locating any particular transformer trouble. A large part of this discussion, however, would be applicable only to small central-station work where transformers are more or less reconnected and repaired locally. Furthermore, a great number of the odd or so called emergency connections would not, as a rule, be feasible, due to the fact that they require 50 or 86% taps, which are not commercially standard except on very small units.

The chapters on various methods of cooling, and also on construction of large transformers, are of particular value to the construction engineer as well as to the operating man. The advice given is practical and shows that the author is thoroughly familiar with this phase of the work. The discussion of transformer reactance as affecting the mechanical stability of the coils brings out a point which is apt to be overlooked and which is becoming more and more important, due to the present-day tendency of interconnecting large systems.

The subject of series transformers is treated in an instructive manner and contains information which has hitherto been neglected by most authors. The chapter could have been made more valuable, however, by working out the different combinations of connections in a more definite manner and showing their relation to various operating results to be obtained. There is also considerable room for expansion on the subject of polyphase metering, giving not only the proper connections for such work, but also some of the customary faulty ones, together with the effect of the latter upon the accuracy of the meter reading. Clear and concise data along these lines would often be of distinct financial value to the operating man, in cases of questionable meter readings.

It is to be regretted in this day of outdoor substations that the author did not see fit to take up the matter of outdoor transformers, together with the various problems of cooling, waterproofing, etc. The relative advantages of oil- versus water-cooled transformers under extreme conditions of temperature, and the methods of internal temperature regulation to meet such extremes, would have been a subject worthy of extended discussion.

A chapter on transformer costs would also have been of particular interest to the commercial engineer, giving at least rough unit costs for various capacities, and the approximate variation in cost due to differences in frequency, voltage, methods of cooling, etc. The conditions affecting transformer cost are, of course, exceedingly varied, but at the same time there is a more or less fixed relation between such costs on transformers of different type and voltage which, if given even roughly, would be of great value in making comparative estimates.

The book as a whole is a valuable reference work for the central-station operating man, both as a help in diagnosing transformer trouble and in suggesting emergency connections for temporary work. The practical application of vector diagrams to the various possible combinations, and the very definite warning which is sounded against certain impossible combinations, are features which add greatly to its value. There is, nevertheless, a considerable field for expansion of the subject along some of the lines above suggested, and this improvement would make the volume of still more interest and value to engineers connected with the more extensive high-voltage systems.

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Logging Principles and Methods

LOGGING; The Principles and General Methods of Operation in the United States—By Ralph Clement Bryant, Manufacturers' Association Professor of Lumbering, Yale University. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. xviii + 590; 133 illustrations. $3.50 (15/-), net.

A large amount of useful information on the logging industry as practiced in the United States is given in this book, which is designed for use in forest schools.

A concise review of the forest resources of the country by species of trees, a chapter on the protection of forest property, and a few pages on timber bonds as a means of financing logging operations, serve as a general introduction. Part II, on preparing logs for transport, deals with labor, camps, tools, felling trees and cutting them into logs, and log measurement. Parts II and III are devoted to land and water transportation, respectively, each of which is taken up in detail. Part V summarizes the logging methods of specific regions and Part VI deals with the production of turpentine and stripping tanbark.

A feature of the book is its references at the close of each chapter, which are gathered into a bibliography in an appendix. The appendix also includes a glossary of logging terms, besides log rules and contents, wage lists, stumpage values and a partial estimate of the standing timber of the United States.

The well-chosen illustrations add to the interest and value of a book which promises to be not only a standard text for forest schools and forestry courses but also of use to foresters and lumbermen generally, as well as to engineers who may have to engage or assist in logging operations.

DISPOSAL OF NEW YORK'S SEWAGE—Preliminary Reports. New York: Metropolitan Sewerage Commission, 17 Battery Place. Paper; 9x12 in.; illustrated.

No. VIII., Tidal Currents in New York Harbor as Shown by Floats. Pp. 46.

No. IX., Rainfall and the Relations Between the Volumes of Domestic Sewage, Storm Water and Tidal Water in New York Harbor. Pp. 21.

No. X., Recommendation for a Commission to Construct a System of Main Drainage and Sewage Disposal for New York and Showing the Urgency Therefor. Pp. 7.

Reports VIII and IX will be welcomed by those concerned with tidal currents and rainfall in relation to the problems of sewage disposal, although in each case the data, as is proper, are chiefly of local value.

A large number of float maps are shown in the bulletin on tidal currents. The rainfall bulletin contains some intensity tables of much more than local interest, and also some unique tables showing for 1910 and 1940 the tons of suspended and organic matters which were and, it is estimated, will be discharged into various divisions of the waters surrounding the city assuming (1) no treatment of the sewage and (2) treatment by one or the other of various current methods.

Report X is a brief review of the work of the Commission since its creation in 1906. The report contains a list of the various experts on sewage treatment consulted by the Commission and urges the creation of a new commission, charged with the duty of carrying out the plans which the present Commission will recommend in the final report which it expects to file by April 30.

Some notes on sewage and garbage disposal in various European cities are given in "Daily Consular and Trade Reports" for Feb. 4, 1914 (Washington, D. C., Department of Commerce). The notes appear to have been condensed from special consular reports on file in the Department of Com-

merce. The value of the notes would have been increased had they been written with a fuller knowledge of the subjects treated, so emphasis could have been laid upon the more significant of the various facts presented for each city.

Concrete Specifications

Reviewed by ROBERT W. BOYD*

GENERAL SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE, Including Finishing and Waterproofing—By Jerome Cochran, Jun. M. Am. Soc. C. E., author of "Cement Specifications," "Inspection of Concrete Construction," etc. New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. xxiii + 274; 21 text figures. $2.50, net.

This compilation of specification data, culled from many sources, covers practically the entire field of concrete and reinforced-concrete construction. The chapter headings are a fair indication of the scope and general arrangement of the book:

Concrete Materials; Proportioning and Mixing Concrete; Forms and Centering; Steel Reinforcement; Transporting and Placing of Concrete; Finishing Concrete Surfaces; Waterproofing Concrete Work; Design of Reinforced Concrete; Reinforced-Concrete Building Construction.

The preface reviews the work of the several committees on concrete and reinforced concrete. An introduction outlines the essential elements in concrete construction, and an appendix gives the formulas suggested by the Special Committee on Concrete and Reinforced Concrete of the American Society of Civil Engineers. At the ends of the chapters are numerous references to literature bearing on the matter discussed.

There are designers who will be disappointed in not finding in this work specification forms already prepared which they may adapt to their own uses without much labor. However, the generally logical arrangement, the exhaustive treatment of the subject matter and the ease with which individual items may be found by means of the numbered paragraphs and an excellent index are valuable attributes which go far toward making up for the many shortcomings of the book. It should not be a difficult matter to prepare a specification for almost any concrete structure from the mass of information here presented. The preparation of the book has undoubtedly required much time and labor, not without result.

If a book, such as the present, gains in value as it omits material not strictly germane to its subject together with material of questionable verity or small practical value, the present work of the author could be considerably abridged without impairing its usefulness. The value of the introduction, occupying more than eight pages, is not apparent inasmuch as the experienced engineer will find therein nothing new either in material or statement, and the beginner will find little that will be instructive without amplification. In fact, the introduction, with the exception of the last paragraph, might well be omitted, and the last paragraph makes unnecessary a large part of the preface. Although the article on detailing reinforced-concrete structures and on drafting-room practice, occupying twenty-five pages, is of undoubted value, it is out of place in a book on specifications. In numerous other instances paragraphs are included which add nothing but bulk.

A large amount of explanatory matter has been included, combined with specification forms. In compilations of this kind, a certain amount of text is necessary and desirable by way of explanation or caution. In the present work, had this material been excluded from the numbered paragraphs and set forth independently in different type, the specification forms could have been picked out with greater ease and the usefulness of the book enhanced. It is doubtful whether an arrangement which relegates to foot-notes many of the requirements of the Joint Committee, while the author's substitutes occupy the text, will add to the authoritative character of the book. There are a number of useless repetitions. A few inconsistencies, sometimes in the same paragraph, require correction. The text is marred in a number of places by the use of words and forms of expression which if not actually incorrect are at least contrary to accepted usage.

HISTORY OF BRINGING THE ATCHISON, TOPEKA & SANTA FE RAILWAY TO GALESBURG—By Col. Clark E. Carr. Galesburg, Ill.: The Author. Cloth; 6x9 in.; pp. 85; illustrations. 60c.

Although but the record of a local event this little book throws an interesting side light on a certain phase of railway location and construction—somewhat amusing when viewed at a distance of time, but vitally important to communities like Galesburg at one period of their existance, and well worthy of a place in a city's history.

In 1887-'88 the Atchison, Topeka & Santa Fé Ry. had surveyed its main line from Kansas City to Chicago so that it was about ten miles south of Galesburg, Ill. The citizens of Galesburg wanted the railway to pass through the city, although it was already on the line of the Chicago, Burlington & Quincy R.R.

After the use of many influences the Chief Engineer, A. A. Robinson was persuaded to visit Galesburg. After being entertained, as only a man whose say-so is of such vital importance ever is entertained, he said he would consider a location through Galesburg if the city would furnish station grounds, right-of-way and other inducements.

The little book before us relates how all this was done, giving much interesting correspondence between the parties to the contract. One of the final letters, from W. B. Strong, then President of the Santa Fé, emphatically denies that the railway would have been built through Galesburg anyway—a pernicious rumor which the letter implies was gaining currency some ten years after the transaction had been completed.

The book is illustrated with portraits of some of the chief participants.

GOVERNMENT OWNERSHIP OF RAILWAYS—By Samuel O. Dunn, Editor of the "Railway Age Gazette"; author of "The American Transportation Question." New York and London: D. Appleton & Co. Cloth; 5x8 in.; pp. vii + 400. $1.50, net.

Within the past few years there has been a very marked development of the policy of government regulation and control of the railways in this country and numerous steps have been taken toward the increased practical application and enforcement of this policy. There has been a less important growth of the idea of government ownership of railways, and as yet there has been no practical application of this, for government ownership of our railways in Panama and the Philippine Islands is under conditions entirely different from those obtaining in North America. Mr. Dunn's book deals, therefore, with a question of public interest and importance at this time.

The first period of railway affairs in this country was that of private ownership and management with practically no governmental regulation. Several causes have led to a gradually increasing creation and exercise of regulatory power by the government, and this action has not yet reached its full development. A problem which is being brought more and more prominently before the public mind is whether the present policy of private ownership and management under government regulation shall be continued, or whether a further and very radical step shall be made to the policy of government ownership of the railways.

In this book, the different systems in force in other countries are discussed, with their results in regard to service, rates, finance, labor conditions, economy and political effects. The information is presented very fairly and judiciously, and appears to warrant the author's conclusions as unfavorable to the adoption of the government ownership policy in this country. The difference in political, social and economic conditions strongly supports this view. For instance, it is pointed out that the successful results of government-owned railways in Prussia are obtained under conditions as to form of government and political institutions which people in this country would "regard as inconsistent with the rights of the individual to great freedom of action and with the right of the people as a whole to govern themselves." The same applies very largely in the case of the government-owned railways of Japan.

The countries outside of the United States which present the most valuable experience in regard to private ownership are England, France, Canada and Argentina. In England there is now an agitation (largely a labor agitation) for government ownership and in France the existing partial ownership of railways is on the increase. The countries which present the most valuable experience in regard to government ownership are Germany, France, Belgium, Switzerland, Italy, Austria-Hungary, Australia, Canada and Japan.

It is the author's opinion that the results of the introduction of government ownership of railways in this country would be about as follows: 1, increase in expenses; 2, no greater safety in operation; 3, less rapid development of the railway system; 4, lower passenger rates; 5, higher freight rates (while low freight rates are of more benefit to the public than low passenger rates); 6, no improvement of labor conditions without imposing additional burdens in the way of higher fares, freight rates or taxes, and 7, a tendency to corrupt rather than to purify politics.

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The descriptions and conclusions are presented readably and concisely, and yet convincingly, bearing evidence that the author has analyzed and considered his subject carefully, even though he undoubtedly is opposed to the policy of government ownership. But no author competent to discuss the subject could be free from a definite opinion in favor of one or other side of the question, and the treatment of the subject in this case indicates reasoning and not prejudice as the basis of the conclusions.

Graphics of Cranes and Trusses

Reviewed by LEWIS E. MOORE*

ELEMENTARY GRAPHIC STATICS—By John T. Wight, Lecturer in Machine Design and Prime Movers, Heriot-Watt College, Edinburgh. New York and London: Whittaker & Co. Cloth; 5x8 in.; pp. xii + 227; 135 text illustrations. $1.25, net.

The volume under review is intended to present Graphic Statics to the first-year students of British technical schools.

The first chapter takes up definitions and specifications of forces, resultants, etc. The second chapter treats of the composition and resolution of forces in simple cases of concurrent forces. The third chapter is devoted to the solution of various problems, principally those having to do with cranes of different types. The author then takes up the composition of non-concurrent forces, the funicular polygon, the graphical representation of moments for various systems of forces, including couples, and closes with two pages of examples. The next chapter treats moment and shear diagrams by graphical and combination methods. Many different cases are illustrated. The sixth chapter takes up beams with rolling loads. The maximum moments and shears are calculated and graphics are only used to represent the results of calculations. Chapter VII discusses and illustrates 17 varieties of roof trusses and shows how to draw stress diagrams for dead loads, although much unnecessary work is done because diagrams are drawn for both halves of symmetrical and symmetrically loaded trusses. The next two chapters treat various cases of unsymmetrical loads and wind loads. Several trusses are illustrated, and the diagrams drawn for them.

Braced beams and girders are next considered, beginning with a trussed stringer. The author makes the unqualified statement that the stress in the center post is ½ of the center load on the beam, which is by no means always true. The author takes occasion to illustrate the Fink and Bollman trusses in the form in which they were used for bridges, and states that the former is "largely used in America." Warren and Pratt trusses and lattice girders are illustrated and solved. Chapter XI treats centers of gravity and moments of inertia by graphical methods, and the final chapter takes up retaining walls and some earth pressure theories very briefly.

In the opinion of the reviewer the book goes too far in certain directions and not far enough in others. For instance, in Chapter VII one or two varieties of trusses would be amply sufficient to illustrate the drawing of dead-stress diagrams, while no less than 17 are shown.

The book might better be called the "graphics of cranes and trusses," for it treats of little else. Of the real theory of graphics not enough is given. For instance, the correction of a funicular polygon, or the passing of the polygon through two or three given points, is nowhere touched upon, neither are the well known graphical methods of finding moments and shears for moving loads. The student who carefully works through this book will learn something about the solution of roof-trusses by graphical methods.

The tendency of most British technical writers, of which this book is a partial illustration, seems to be to lean toward unnecessary verbosity and to obscure the fundamental principles with too many detailed solutions of particular problems. This tends to the production of narrow treatises which have the effect of superseding thought on the part of the student, whereas a textbook should be merely an exposition of general principles with only sufficient illustration to stimulate the student's curiosity and teach him to think. A treatise is a boon to the lazy teacher (or pupil) but does not tend to produce students capable of independent thought.

PREVENTION AND CONTROL OF DISEASE—By Francis Ramaley, Professor of Biology, and Clay E. Giffin, Instructor in Surgery; University of Colorado. Boulder, Colo.: The University Store. New York: G. E. Stechert & Co. Cloth; 6x9 in.; pp. 386; illustrated. $3, postpaid.

Every book must be judged with regard to the class of readers for which it was intended. The authors declare that this volume was "intended for the general public" and "college classes" and not "for medical students, practicing physicians or biologists of any kind." Earlier in their Preface the authors make it plain that the object of their book is to secure the coöperation of "an intelligent body of citizens" in the disease-prevention work heretofore carried on chiefly by "laboratory investigators, physicians and public health-officials.

Judged by the standard outlined the book must be considered a success and worthy of wide circulation and reading. It deals in plain every-day language with disease-prevention and health. Specific diseases are considered, including some that are not in the communicable class. There is a separate chapter on disinfection and disinfectants. Sanitary engineering topics are not listed, although the value of pure water and the relation of sewage-polluted water to typhoid fever are clearly stated.

A READER OF SCIENTIFIC AND TECHNICAL SPANISH for Colleges and Technical Schools, with Vocabulary and Notes—By Cornelis DeWitt Willcox, Lieutenant Colonel, United States Army; Professor, U. S. Military Academy; New York: Sturgis & Walton. Cloth; 5x8 in.; pp. 588; 57 text figures. $1.75, net.

An engineer's knowledge of a language must necessarily be more comprehensive than that of most laymen. In addition to the standard vocabulary he must be familiar with a long list of technical terms and idioms, if he is to make use of the language. To aid in gaining this familiarity is the object of the Spanish reader before us.

The book is designed for use in colleges and technical institutions, but it is just as applicable to home study, provided the reader already has some knowledge of the language. The book includes a very good Spanish-English technical vocabulary.

The 19 chapters cover most of the subjects concerning which an engineer should be conversant: physics, chemistry, steam, railroads, automobiles, airships, submarines, bridges, minerals and topography.

At first blush, it might appear that the author had striven to cover too much; but since his object was not to teach engineering but engineering wording, broadness was essential.

THE IMPROVEMENT OF TOWNS AND CITIES or the Practical Basis of Civic Esthetics—By Charles Mulford Robinson, author of "Modern Civic Art," "The Width and Arrangement of Streets," "The Call of the City," etc. Fourth revised edition. New York and London: G. P. Putnam's Sons. Cloth; 5x7 in.; pp. xv + 313. $1.25, net.

By "improvement" the author has in mind esthetic improvement, but under "Foundations of Civic Beauty" he first discusses the site of the city, the street plan, bridges, street paving, cleaning and lighting. Under "Beauty in the Street," he deals further with such practical matters as wires, the smoke nuisance and noise. In other parts of the book are found chapters on parks and playgrounds, architecture and sculpture and the betterment work of private organizations and public officials.

The book first appeared a dozen years ago and has since been "revised" three times. All the revisions appear to have been slight, but this matters less in this particular book than in many others since it is concerned more particularly with principles and inspirations which change but slowly if at all.

FRICTIONAL RESISTANCE IN ARTIFICIAL WATERWAYS—By V. M. Cone, R. E. Trimble and P. S. Jones. Bulletin 194, Agricultural Experiment Station of the Colorado Agricultural College, Fort Collins, Colo. (The work on which this report is based was done under a coöperative agreement between the Office of Experiment Stations of the U. S. Department of Agriculture and the Colorado Experiment Station.) Paper; 6x9 in.; pp. 48; illustrated.

The object of the studies reported on in this bulletin was "to add to the available information on proper values of the coefficient of roughness in various types of artificial waterways." During the irrigation seasons of 1912 and 1913 field experiments were made upon steel, reinforced-concrete and timber flumes, earth and concrete-lined canals, timber and concrete chutes, and inverted siphons of wood-stave pipe. The various waterways studied were located on irrigation works in six different Colorado valleys.

Besides determining the value of "n," observations were made on the loss of head in water flowing through siphons. Current-meter measurements were also made, vertical velocity curves plotted and the integration and single-point methods were compared with the multiple-point methods, as regards accuracy.

The investigations are described by means of text, line drawings and halftone views. The data secured and con-

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clusions drawn are concisely presented. The bulletin promises to be of much interest and value to all interested in the flow of water in open channels and in certain kinds of siphons.

The Business Doctor

INVESTIGATING AN INDUSTRY: A Scientific Diagnosis of the Diseases of Management—By William Kent, author of "The Mechanical Engineer's Pocket Book" and of "Steam Boiler Economy." With an Introduction by Henry L. Gantt, author of "Work, Wages and Profits." New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5x8 in.; pp. xii + 126. $1 (4½ shillings), net.

Mr. Kent's thesis, as explained by Mr. Gantt in the preface to this book, is that "scientific management" relates to every phase of industry, including the functions of directors and salesmen. By "scientific management," one gathers from the first few pages, is meant the constant scrutiny of product, processes, machines, labor, supervision, investment, market, etc., to see if all demonstrated improvements are or can be well applied and false efforts eliminated, reduction of producing cost being the goal.

The discussions, after the first dozen pages, take narrative form. The story turns about an industry which lost $15,000 one year and made $69,000 the second year, the latter all on account of increased production. The market is supposedly invaded by a competitor. One of the directors realizes that there is not business enough for all and that with reduced production continued losses are before the company. The perturbed directors finally call in a "business doctor" who tells them he is an ex-physician, explains how he proceeds to diagnose plant failures, and describes the seven bugs in business which he first looks for. The upshot of the matter is, of course, that they accept his services and he begins his probes in the concern's activities, disclosing things which a "scientific management expert" has not unearthed in the scientifically perfect factory system that the technically perfect but narrow-minded factory manager has designed. The scheme that the Doctor works out for developing the company so that its plant is best utilized and its selling methods safer are interestingly told. Probability limit is almost reached, however, when most of the old directors efface themselves and install as their successors the works manager, the sales manager, the old chief clerk and, of course, the Doctor who has an option to purchase 20% of the stock at 90, as his fee for moving the concern back from the precipice.

There are a few touches about the book which might lead the reader to think that the author considers himself the Doctor and this story a composite of his personal experiences—plus considerable imagination.

NEW PUBLICATIONS

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION—Proceedings of Convention, June 11-13, 1913. Chicago, Ill.: Jos. W. Taylor, Secretary, 1112 Karpen Bldg. Cloth; 6x9 in.; pp. 193; illustrated.

AMERICAN WATER WORKS ASSOCIATION—Proceedings of Convention, June 23-27, 1913. Troy, N. Y.: J. M. Diven, Secretary. Paper; 6x9 in.; pp. 169.

The business proceedings are here given, with list of members, etc. The papers will appear, as usual, in a separate volume.

AMERICA'S TRIUMPH AT PANAMA: Panorama and Story of the Construction and Operation of the World's Giant Waterway from Ocean to Ocean—By Ralph Emmett Avery, author of "A Trip to Panama." Edited by William C. Haskins, of the "Canal Record." Chicago, Ill.: Regan Printing House. Cloth; 8x11 in.; pp. 384; profusely illustrated. $2.

ARITHMETIC OF THE STEAM BOILER: A Reference Book Showing the Various Applications of Arithmetic to Steam Boilers—By Charles J. Mason. [The "Power" Handbooks.] New York and London: McGraw-Hill Book Co., Inc. Cloth; 4x7 in.; pp. xi + 225; illustrated. $1, net.

DIE BERECHNUNG VON BOGENFORMIGEN STAUMAUERN [Doctor dissertation]—By H. Ritter. Karlsruhe, Germany: J. Lange's Buchdruckerei, Waldstrasse 13. Paper; 6x9 in.; pp. 83; 30 text figures.

BULLETINS OF THE ENGINEERING EXPERIMENT STATION, UNIVERSITY OF ILLINOIS (Urbana, Ill.)—Vol. VIII, Bulletins 58-62, May-December, 1912. Vol. IX, Bulletins 63-67, January-June, 1913. Cardboard; 6x9 in.; illustrated.

CHEMISCHE APPARATUS: Zeitschrift fur die Maschinellen und Apparativen Hilfsmittel der Chemischen Technik. Leipzig, R.: Otto Spamer. Vol. I, No. 1. Paper; 9x12 in.; illustrated. Quarterly, 4 Marks.

A new publication dealing with the development of machines and apparatus used in the chemical industry. Published twice a month.

COAL WASHING IN ILLINOIS—By P. C. Lincoln. Urbana, Ill.: University of Illinois. Bulletin 69, Engineering Experiment Station. Paper; 6x9 in.; pp. 110; illustrated. 50c.

CODE OF SUGGESTED ORDINANCES FOR SMALL MUNICIPALITIES—Adopted by the National Board of Fire Underwriters, 135 William St., New York, and the National Fire Protection Association, 87 Milk St., Boston, Mass. Paper; 6x9 in.; pp. 24.

Contains model ordinances on Fire Limits and Construction and Equipment of Buildings, Automobile Garages, Equipment and Operation of Picture Machines and Inspection of Premises by the Fire Department, Cleanliness of Streets, Alleys and Premises, Burning of Refuse, Storage of Explosives, Discharge or Firing of Fireworks and Fire Escapes.

COMMISSION REGULATION OF PUBLIC UTILITIES: A Compilation and Analysis of Laws of Forty-Three States and of the Federal Government for the Regulation by Central Commissions of Railroads and Other Public Utilities. New York: National Civic Federation, Department on Regulation of Interstate and Municipal Utilities, 1 Madison Ave. Cloth; 6x9 in.; pp. 1284. $8.50.

CONDENSED REPORT OF THE INVESTIGATION OF REINFORCING BARS REROLLED FROM STEEL RAILS—By W. K. Hatt. (Conducted under Instructions from Sub-Committee V, on Steel Reinforcing Bars, of Committee A-1, American Society for Testing Materials.) Philadelphia, Penn.: Prof. Edgar Marburg, University of Pennsylvania, Secretary. Paper; 6x9 in.; pp. 31; illustrated.

DANGERS TO WORKERS FROM DUSTS AND FUMES AND METHODS OF PROTECTION—Washington, D. C.: Bureau of Labor Statistics. Bulletin 127. Paper; 6x9 in.; pp. 22; illustrated.

ECONOMICS OF INTERURBAN RAILWAYS—By Louis E. Fischer, Consulting Engineer. New York and London: McGraw-Hill Book Co., Inc. Cloth; 5x8 in.; pp. ix + 116. $1.50.

THE ELECTRIC FURNACE, Its Construction, Operation and Uses—By Alfred Stansfield, Birks Professor of Metallurgy in McGill University. Second edition, revised, enlarged and reset. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xiii + 415; 155 illustrations. $4, net.

ELECTRICAL ENGINEERING PROBLEMS—Part I, Direct Current Circuits and Apparatus; Part II, Alternating Current Circuits and Apparatus. By F. C. Caldwell, Professor of Electrical Engineering, Ohio State University. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 105. $1, net.

ELEMENTARY STATICS; A Supplement to Franklin and MacNutt's "Mechanics and Heat." South Bethlehem, Penn.: Franklin, MacNutt & Charles. Paper; 6x9 in.; pp. 45; 65 text figures. 50c.

ELEMENTS OF ALTERNATING CURRENTS: Instruction Paper—Prepared by John Mills, Engineering Department, American Telephone & Telegraph Co.; formerly Professor of Physics and Electrical Engineering, Colorado College. Chicago, Ill.: American School of Correspondence. Cloth; 6x9 in.; pp. 94; 74 text figures. 50c.

ERNEST KEMPTON ADAMS FUND FOR PHYSICAL RESEARCH—Publication No. 7: Neuere Probleme der Theoretischen Physik (Six Lectures Delivered in Columbia University in April, 1913, by W. Wien, Professor of Physics, University of Wurzburg; Lecturer of Mathematical Physics, Columbia University for 1913) Leipzig and Berlin: B. G. Teubner. Paper; 10x13 in.; pp. 76; illustrated.

THE ESTHETIC TREATMENT OF CITY BRIDGES—By Henry Grattan Tyrrell, Consulting Engineer, Evanston, Ill. [No. 101, "The American City" Pamphlets.] New York: The Civic Press, 93 Nassau St. Paper; 7x10 in.; pp. 8; illustrated. 15c.

FACTORY ORGANIZATION AND ADMINISTRATION—By Hugo Diemer, M. Am. Soc. M. E., Professor of Industrial Engineering, Pennsylvania State College. Second edition, revised, enlarged and reset. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xv + 378; 174 illustrations. $3, net.

FOWLER'S MECHANICAL ENGINEER'S POCKET BOOK 1914—Edited by William H. Fowler. Sixteenth annual edition. Manchester, England: Scientific Publishing Co. Leather and cloth; 4x6 in.; pp. 576; illustrated. 2½ and 1½ Shillings, net.

FOWLER'S MECHANICS AND MACHINISTS' POCKET BOOK AND DIARY, 1914—Edited by William H. Fowler. Sixth annual edition. Manchester, England: Scientific Publishing Co. Cardboard; 4x6 in.; pp. 469; illustrated. 6 Pence, net.

HOW TO ORGANIZE A CITY PLANNING CAMPAIGN—By Frederick Law Olmsted, Chairman, National Conference on City Planning. [No. 102, "The American City" Pamphlet.] New York: The Civic Press, 93 Nassau St. Paper; 7x10 in.; pp. 8; illustrated. 15c.

HYDRAULIC DATA—By H. D. Coale, Chief Engineer, Pacific Tank & Pipe Co., Portland, Ore. Cloth; 5x8 in.; pp. 93; illustrated. $2. [Sent to hydraulic engineers, water-works superintendents and those directly interested in the distribution of water without cost.]

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS—Proceedings of Annual Meeting, July 11-13, 1912. London, England: Thomas Cole, Secretary, 92 Victoria St., S. W. Cloth; 6x9 in.; pp. 579.

THE JOURNAL OF THE IRON AND STEEL INSTITUTE, Vol. LXXXVIII, No. 2, 1913—Edited by George C. Lloyd, Secretary. London: Offices of the Institute, 28 Victoria St., S. W.; E. & F. N. Spon, Ltd., 57 Haymarket. New York: Spon & Chamberlain. Cloth; 6x9 in.; pp. 783; illustrated.

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